ANNUAL REPORT

OF THE

MAINE STATE COLLEGE

FOR THE

YEAR 1893.

PART II.

Report of the Director of the Agricultural Experiment Station.

AUGUSTA:
BURLEIGH & FLYNT, PRINTERS TO THE STATE.
1894.

MAINE STATE COLLEGE.

AGRICULTURAL EXPERIMENT STATION.

THE STATION COUNCIL.

TRUSTEE RUTILLUS ALDEN .... Winthrop.
PROFESSOR WALTER BALENTINE, M. S. .... Orono.
TRUSTEE BENJAMIN F. BRIGGS .... Auburn.
PRESIDENT ABRAM W. HARRIS, Ph.D .... Orono.
PROFESSOR FRANCIS L. HARVEY, Ph.D .... Orono.
DIRECTOR WHITMAN H. JORDAN, M. S., *Secretary* .... Orono.
REPRESENTATIVE D. H. KNOWLTON, M. A.,
State Pomological Society ..... Farmington.
REPRESENTATIVE B. WALKER McKEEN,
State Board of Agriculture ..... Fryeburg.
TRUSTEE ARTHUR L. MOORE, B. S. .... Limerick.
PROFESSOR WELTON M. MUNSON, M. S. .... Orono.
PROFESSOR FREMONT L. RUSSELL, V. S. .... Orono.
REPRESENTATIVE I. O. WINSLOW, M. A.,
Maine State Grange .... St. Albans.

THE STATION STAFF.

THE PRESIDENT.
WHITMAN H. JORDAN, M. S. .... Director.
*MERRITT C. FERNALD, PH.D .... Meteorologist.
WALTER BALENTINE, M. S .... Agriculturist.
JAMES M. BARTLETT, M. S .... Chemist.
FRANCIS L. HARVEY, PH.D .... Botanist and Entomologist.
LUCIUS H. MERRILL, B. S .... Chemist.
FREMONT L. RUSSELL, V. S .... Veterinarian.
WELTON M. MUNSON, M. S .... Horticulturist.
FRED P. BRIGGS, B. S .... Assistant in Botany and Entomology.
HARRIS P. GOULD .... Assistant in Horticulture.
ANDREW M. SHAW .... Foreman in Experimental Agriculture.
MRS. J. HAMLIN WAITT .... Clerk and Stenographer.

*Resigned September 1, 1893.

TREASURER'S REPORT.

The Maine Agricultural Experiment Station in account with the United States appropriation:

RECEIPTS.

From the Treasurer of the United States as per appropriation for the year ending June 30, 1893	$15,000 00

EXPENDITURES.

Botany and Entomology	$ 14 87	
Chemical Laboratory	281 47	
Expense Account	160 89	
Field and Feeding	1,253 61	
Fertilizer Inspection	134 80	
Horticultural Department	689 56	
Meteorology	30 70	
Printing	1,458 79	
Construction and Repairs	186 04	
Stationery and Postage	93 95	
Traveling Expenses	135 35	
Library	120 85	
Veterinary Science	5 40	
Fuel	140 82	
World's Fair	501 87	
Trustee Expenses	16 00	
Water Supply	200 00	
Salaries	9,574 97	
		$14,999 94

I hereby certify that the above is a correct statement of the amount expended by the Maine Experiment Station for the year ending June 30, 1893.

G. H. HAMLIN, TREASURER,

Trustees of Maine State College of Agr. and the Mech. Arts.

I hereby certify that I have examined the accounts of the Maine Experiment Station for the fiscal year ending June 30, 1893; that I have found the above to be a correct statement of expenditures both as to amount and classification, for all of which, proper vouchers are on file.

HENRY LORD, AUDITOR,

Trustees of Maine State College of Agr. and the Mech. Arts.

TABLE OF CONTENTS.

2nd Series Bulletin 5.

DIRECTOR'S REPORT.

A. W. Harris, Ph. D., President Maine State College.

SIR:—I submit herewith a report of the work performed in the various departments of the Experiment Station for the year 1893:

It is hoped that the facts and discussions therein presented will prove of value to the agriculture of the State, through a careful consideration of their relations to farm practice.

The past year has been one of general prosperity in the affairs of the Station. In one direction, at least, as will be seen by subsequent statements, an addition of equipment and enlargement of work have been made which give promise of results of great value. Better than anything else which could be mentioned, perhaps, is the increasing evidence that the Station is exerting a positively helpful influence in the agricultural affairs of Maine. The large correspondence which has grown up between the Station officers and the farmer citizens of the State, the numerous appeals for aid in various directions and the cordial and sympathetic reception which representatives of the Station receive at farmers' institutes and other public meetings may not only constitute substantial reasons for encouragement, but may also convey to each member of the Station staff a sense of personal gratification. I wish to express in behalf of myself and my associates a grateful appreciation of the pleasant relations which we have come to sustain toward a large number of leading Maine farmers, and of the cordial co-operation of the Board of Agriculture, the State Pomological Society and the Patrons of Husbandry.

FERTILIZER INSPECTION.

The Maine legislature of 1893 enacted a new law for the control of the sale and inspection of commercial fertilizers, of which the Director of this Station is made the executive officer. This work will necessarily and properly be done at the Station.

It is provided that an analysis fee of fifteen dollars shall be paid by the manufacturers, importers or dealers for each distinct brand of fertilizer of which more than thirty tons are sold in Maine, the income thus derived to be used to pay the expenses of the fertilizer inspection and publishing the results. It is even now very evident that this fee is too small. In fact, the experience of ten or twelve years had previously shown that a fee of at least $20 would be needed. It is hoped that the legislature of 1895 will remedy this error by increasing the fee.

THE NEW FORCING HOUSE.

The most notable addition to the Station equipment is the new forcing house, now nearing completion, which is to be used in the study of problems in plant nutrition. The work is to be under the immediate charge of Professor Balentine, who reports on subsequent pages the results of experiments made in the forcing house erected several years since. It is believed that in giving more attention to a scientific study of certain phases of plant nutrition the Station will occupy a field very largely neglected by American experiment stations, this line of study having so far held a place much subordinate to animal nutrition. The new house is 65x18 feet, and is to be equipped in a manner best adapted to its intended purpose.

INCREASE OF MAILING LIST.

At a meeting of the Station Council in the autumn of 1892, it was urged that the list of farmers receiving the publications of the Station should be increased. This matter was left with me for action. After considering several plans, I decided to send to each postmaster in the State a card-board poster showing a cut of the College buildings, and stating thereon that the station publications would be sent free to any Maine farmer requesting them. Through such advertising and by other means that have been adopted, the mailing list of residents of this State has been increased over two thousand names, so that now it numbers between seven and eight thousand. It is doubtful if a larger proportion of the farmers of any state are receiving the bulletins of their experiment station than is the case in Maine. During the year the mailing list has also been revised by sending to each postmaster for correction a list of names previously addressed to his office. In this way a large number of errors were corrected.

STATION PUBLICATIONS.

The large increase that has been made to the mailing list has rendered it necessary to consider the most economical methods of preparing and distributing Station publications. It is very desirable, also, that the manner of presenting the results of experiments and investigations shall be such as to secure for them wide attention. Experience has shown that in order to accomplish this, the statements made by Station officers must be as concise and simple as is consistent with accuracy. On the other hand, it is very important that a certain class of readers, such as other station workers and the farmers who possess scientific knowledge and training, shall have access to a full record of the data upon which are based the conclusions that stand in close relation to farm practice. In view of the foregoing considerations, it has been decided to issue numerous short bulletins, of not over four pages each, which shall be sent to the entire mailing list, and which shall present to the reader, in a form adapted to the unscientific public, all the results of Station work which have an immediate relation to farm practice. There will also be issued an annual report which shall contain a complete record of the doings of the Station, stated in part at least, in a somewhat scientific and technical form. It is proposed that this annual report shall have a circulation limited to the officers and staffs of other stations, certain exchange publications and such farmers as shall specially request that it be sent to them.

ACKNOWLEDGMENTS.

I append a statement of gifts made to the Station, and publications received by the Station free of charge. I wish to make our acknowledgment for these favors.

W. H. JORDAN, *Director*.

MAINE STATE COLLEGE,
ORONO, ME., Dec. 31, 1893.

Donations to the Horticultural Department, 1893.

J. M. Thorburn & Co., New York, N. Y., vegetable seeds.

W. Attle Burpee, Philadelphia, Pa., miscellaneous vegetable and flower seeds.

J. J. H. Gregory & Son, Marblehead, Mass., vegetable seeds.

U. S. Department of Agriculture, Washington, D. C., vegetable seeds, cions, cuttings.

Cornell University, Ithaca, N. Y., cuttings of Russian willows and poplars.

A. M. Smith, St. Catherines, Ontario, six plants Pearl gooseberry.

H. S. Anderson, Union Springs, N. Y., three plants Frontenac gooseberry.

Benjamin F. Sill, Long Island City, N. Y., one rubber plant sprinkler.

Gould's Manufacturing Co., Seneca Falls, N. Y., one Knapsack spraying pump.

The following newspapers and other publications are kindly donated to the Station by the publishers during 1893-4:

Farmers' Home, Dayton, Ohio.

Holstein Friesian Register, Boston, Mass.

Farm and Home, Springfield, Mass.

Jersey Bulletin, Indianapolis, Ind.

Monthly Bulletin, Philadelphia, Pa.

Farmers' Advocate, London, Ont.

Maine Farmer, Augusta, Maine.

Southern Cultivator, Atlanta, Ga.

American Dairyman, New York, N. Y.

The Sun, Baltimore, Md.

Massachusetts Ploughman, Boston, Mass.

Practical Farmer, Philadelphia, Pa.

New England Farmer, Boston, Mass.
Louisiana Planter, New Orleans, La.
Mirror and Farmer, Manchester, N. H.
Texas Farmer, Dallas, Texas.
Hoard's Dairyman, Fort Atkinson, Wis.
Iowa Farmer and Breeder, Cedar Rapids, Iowa.
Detroit Free Press, Detroit, Mich.
Orange County Farmer, Port Jervis, N. Y.
Farm Journal, Philadelphia, Pa.
Delaware Farm and Home, Wilmington, Del.
The Western Rural, Chicago, Ill.
American Cultivator, Boston, Mass.
Farmers' Review, Chicago, Ill.
The Rural Canadian, Toronto, Ont.
Vick's Magazine, Rochester, N. Y.
The Farm and Dairy, Ames, Iowa.
The Clover Leaf, South Bend, Ind.
New York World. (Weekly.)
The Grange Visitor, Lansing, Mich.
The Industrial American, Lexington, Ky.
The American Grange Bulletin and Scientific Farmer, Cincinnati, Ohio.
Agricultural Epitomist, Indianapolis, Ind.
The Prairie Farmer, Chicago, Ill.
Northern Leader, Fort Fairfield, Me.
Farm Life, Rochester, N. Y.
American Agriculturist, New York.
American Creamery, Chicago, Ill.

Investigation on the Foraging Powers of Some Agricultural Plants for Phosphoric Acid.

WALTER BALENTINE.

Of recent investigations in plant nutrition those establishing the fact that leguminous plants are able to gather a portion of their nitrogen either directly or indirectly from the free nitrogen of the air are by far the most important, both from the scientific and the practical stand points.

These investigations settle a question that has attracted the attention of agricultural chemists for half a century. On the practical side the results enable us to say, that it is possible, by growing and feeding to farm animals such plants as peas and clover, to increase the stock of nitrogen for manurial purposes without resorting to the various expensive commercial nitrogenous materials.

Stating the results of these investigations concisely, it has been found that the leguminous plants are able to forage on the atmosphere for a portion of their nitrogen. Other plants either possess this power to a much less degree or not at all. If we look for a reason why this family of plants has attracted so much attention from scientists we find it in the fact that some of its members, the clovers especially, have been found in practical farming to be plants which by their growth on the soil, apparently leave it richer in plant food than before, and that farmers are actually able to produce more of grass, grain and potatoes when clover is used as one of the crops in rotation. It was to learn why a plant that takes up such large quantities of nitrogen as clover, should still leave the ground in a better condition for succeeding crops, that the sources of supply of nitrogen to the leguminous plants have been so carefully studied.

The value of the results of this work to the agriculture of the world cannot be over-estimated. There are, however, other problems in plant nutrition which deserve as careful study as the

nitrogen question and which may yield results of equal practical importance.

All who have given especial attention to the subject of plant nutrition will, undoubtedly, agree that the foraging powers of plants for the elements contained in the ash, vary greatly. This fact is recognized by the majority of observing farmers, as is shown by the following common sayings: Wheat requires a rich soil." "Corn is a grass feeder." "Oats are an exhaustive crop"

Notwithstanding that these views regarding the variation in foraging powers of different crops have been held by many for years, no one is prepared to say just how it is exerted. We are hardly ready to express an opinion whether the greater vigor of certain plants as compared to other species grown on the same soil is due to their superior foraging powers for all of the elements contained in their ash, or for one or more particular elements.

It seems quite as likely, however, that some plants are able to use certain soil compounds of potash or phosphoric acid, which are not available to other plants, as it did that the legumes were able to obtain nitrogen from sources that were not available to the grasses.

Believing that a study of the foraging powers of different agricultural plants would reveal facts of scientific interest, and at the same time of practical value to agriculture, the writer commenced a series of experiments, in the fall of 1892, designed to test the readiness with which different plants obtain their phosphoric acid from insoluble phosphates.

The reason why phosphoric acid was selected on which to make these first studies, in preference to any other substance was, that in practical manuring with crude phosphates, and also in their use in experimental work, different crops had apparently showed decided differences in their abilities to gather phosphoric acid from such a source.

EXPERIMENTAL METHODS.

In order to have the work as much as possible under control the experiments were conducted in boxes in the college forcing house. These boxes were of wood, fifteen inches square and twelve inches deep. For soil a fine sand was used, taken from a sand bank about three feet below the surface. This sand was drawn to the forcing house, screened and thoroughly mixed by repeatedly shoveling it over, after which a sample was taken and the content of potash

and phosphoric acid determined, with the following result: Potash, 0.096 per cent; phosphoric acid, 0.012 per cent.

One hundred and twenty pounds of sand were used in each box.

For each kind of plant studied nine boxes were used, in three sets of three boxes each.

The three boxes of each set received the following manuring per box:

SET I	8.5 grams nitrate of soda = 1.36 grams nitrogen.	
	2.6 grams muriate of potash = 1.36 grams potash.	
SET II	8.5 grams nitrate of soda = 1.36 grams nitrogen.	
	2.6 grams muriate of potash = 1.36 grams potash.	
	17.0 grams South Carolina rock =	3.96 grams insoluble phosphoric acid. 0.39 grams citrate soluble phosphoric acid.
SET III	8.5 grams nitrate of soda = 1.36 grams nitrogen.	
	2.6 grams muriate of potash = 1.36 grams potash.	
	28.5 grams acidulated South Carolina rock =	3.34 grams soluble phosphoric acid. 0.50 grams citrate soluble phosphoric acid. 0.62 grams insoluble phosphoric acid.

It will be seen that all of the boxes were treated alike with reference to potash and nitrogen, that the plants grown in Set I were dependent on the phosphoric acid originally in the sand, that those grown in Set II had in addition 4.32 grams of phosphoric acid, mostly insoluble, supplied by crude finely ground South Carolina rock, and that those grown in the boxes of Set III had in addition to that originally contained in the sand 4.46 grams of phosphoric acid, mostly soluble, supplied in acidulated South Carolina rock.

The plants thus far studied have been wheat, barley, corn, beans, peas, potatoes and turnips.

Wheat was planted in the boxes of			Set I A, Set II A and III A.
Barley	"	"	Set I B, Set II B and III B.
Corn	"	"	Set I C, Set II C and III C.
Beans	"	"	Set I D, Set II D and III D.
Peas	"	"	Set I E, Set II E and III E.
Potatoes	"	"	Set I F, Set II F and III F.
Turnips	"	"	Set I G, Set II G and III G.

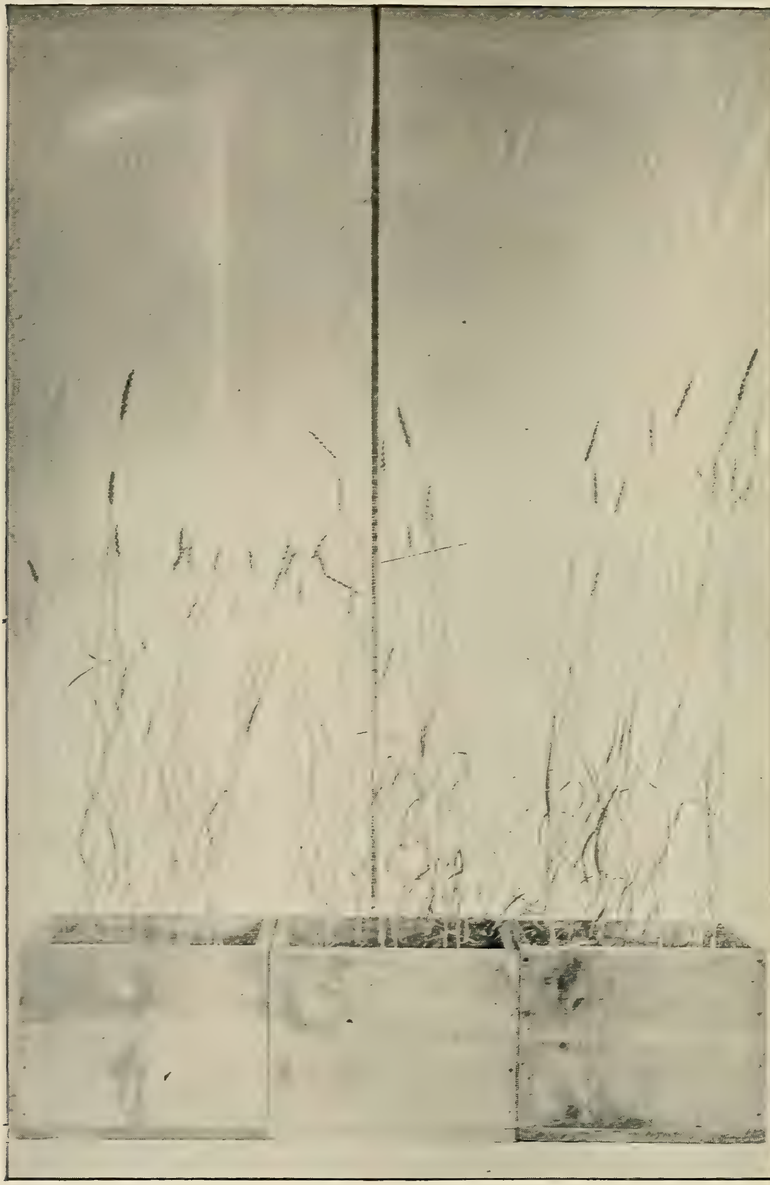
After planting, the boxes were under the care of a man experienced in growing plants under glass. Water was supplied as it was believed to be needed. At the proper time the plants were thinned so that the boxes having the same kind of plants contained the same number of plants to the box.

The plants were allowed to grow to maturity. Immediately before harvesting, the crops were photographed and plates made

showing the relative development of the plants produced. At the time of harvesting, the crops of wheat, barley, corn, peas and beans produced in each box were weighed separately in an air dry condition, after which the amount of dry matter was determined in the combined crop of the three boxes of each set. In the combined crop of each set the nitrogen was determined as well as the phosphoric acid, potash and other mineral matters.

With the pototoes and turnips the crops were weighed fresh at harvesting. In other respects these crops were treated like the others.

The results of this investigation are shown in the following tables with the accompanying plates :

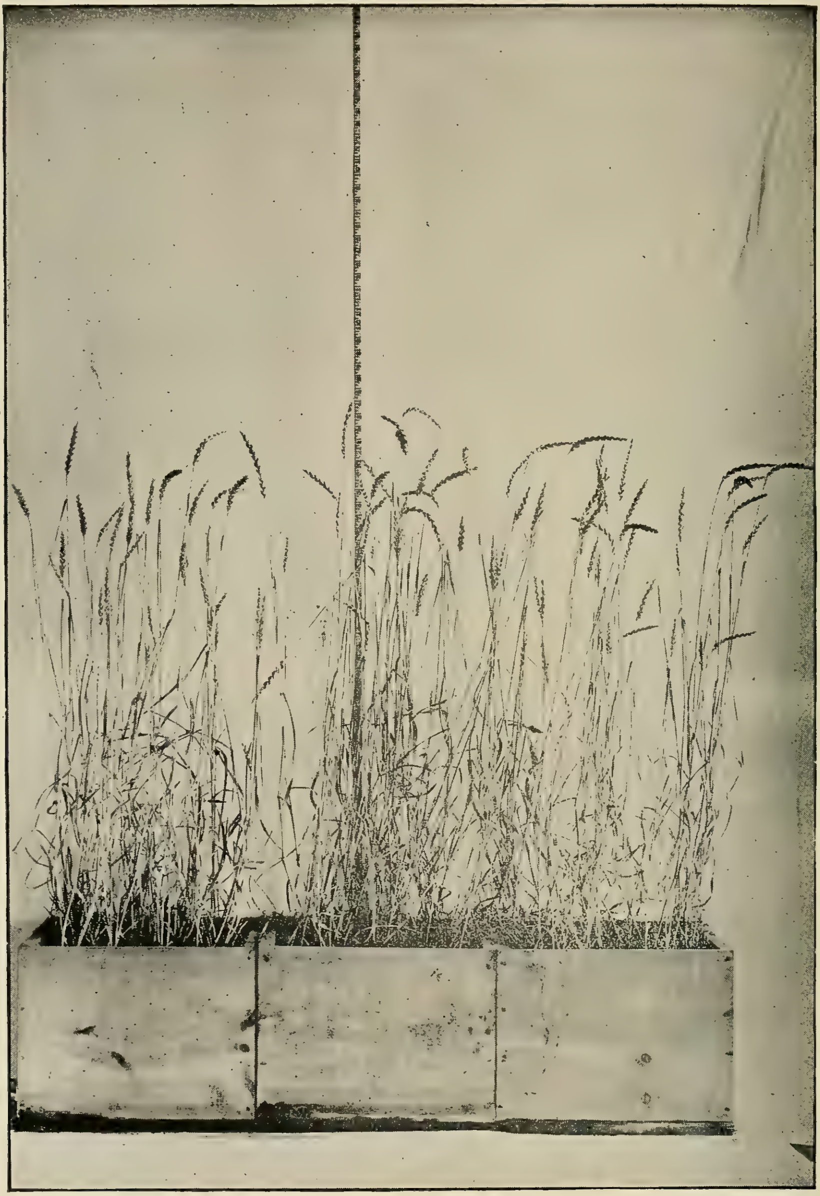


CROP. WHEAT.

Manures.—Nitrate of Soda. Muriate of Potash.

CROP, WHEAT.

Manure,—Nitrate of Soda, Muriate of Potash, S. C. Rock Phosphate



CROP, WHEAT.

Manure,—Nitrate of Soda, Muriate of Potash, Acidulated S. C. Rock Phosphate.

TABLE I.

EXPERIMENT WITH WHEAT.

Set.	Manure per box.	No. of box.	Total crop.	Grain.
I A..	Nitrate of soda, 8.5 grams, and muriate of potash, 2.6 grams.	1	22 grams	7 grams
		2	26 grams	8 grams
		3	36 grams	11 grams
		Total..	84 grams	26 grams
II A..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and crude South Carolina rock, 17 grams.	1	46 grams	15 grams
		2	79 grams	24 grams
		3	37 grams	11 grams
		Total..	162 grams	50 grams
III A..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and acidulated South Carolina rock, 28.5 grams.	1	103 grams	32 grams
		2	92 grams	30 grams
		3	130 grams	43 grams
		Total..	325 grams	105 grams

Dry matter.

Set I A .... 76.9 grams
Set II A .... 148.6 grams
Set III A .... 296.3 grams

TABLE II.

EXPERIMENT WITH BARLEY.

Set.	Manure per box.	No. of box.	Total crop.	Grain.
I B....	Nitrate of soda, 8.5 grams, and muriate of potash, 2.6 grams.	1	78 grams	19 grams
		2	54 grams	9 grams
		3	83 grams	16 grams
		Total..	215 grams	44 grams
II B...	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and crude South Carolina rock, 17.0 grams.	1	88 grams	22 grams
		2	118 grams	18 grams
		3	106 grams	21 grams
		Total..	312 grams	61 grams
III B..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and acidulated South Carolina rock, 28.5 grams.	1	174 grams	4 grams
		2	175 grams	3 grams
		3	189 grams	10 grams
		Total..	538 grams	17 grams

Dry matter.

Set I B .... 201.5 grams
Set II B .... 294.9 grams
Set III B .... 508.1 grams

PLATE I. B.

CROP. BARLEY.

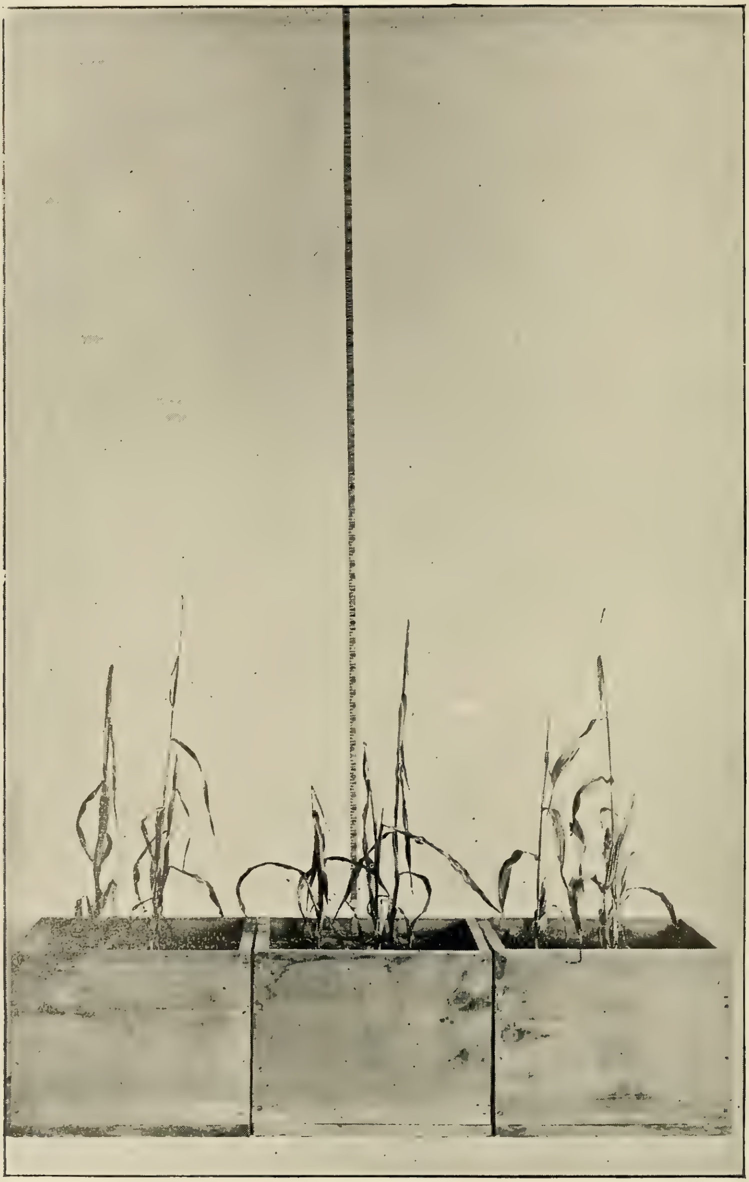
Manure,—Nitrate of Soda, Muriate of Potash.

CROP, BARLEY.

Manure,—Nitrate of Soda, Muriate of Potash, S. C. Rock Phosphate.

CROP. BARLEY.

Manure,—Nitrate of Soda, Muriate of Potash, Acidulated S. C. Rock Phosphate.



CROP CORN.
Manure,—Nitrate of Soda, Muriate of Potash.

CROP, CORN.

Manure,—Nitrate of Soda, Muriate of Potash, S. C. Rock Phosphate.

CROP, CORN.

Manure,—Nitrate of Soda, Muriate of Potash, Acidulated S. C. Rock Phosphate.

TABLE III.

EXPERIMENT WITH CORN.

Set.	Manure per box.	No. of box.	Total crop.
I C..	Nitrate of soda, 8.5 grams, and muriate of potash, 2.6 grams.	1	15.0 grams
		2	15.0 grams
		3	15.0 grams
		Total..	45.0 grams
II C..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and South Carolina rock, 17.0 grams.	1	46.0 grams
		2	53.0 grams
		3	29.0 grams
		Total..	128.0 grams
III C..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and acidulated South Carolina rock, 28.5 grams.	1	164.0 grams
		2	129.0 grams
		3	129.0 grams
		Total..	422.0 grams

Dry matter.

Set I C.. 39.5 grams
Set II C.. 103.3 grams
Set III C... 291.0 grams

TABLE IV.

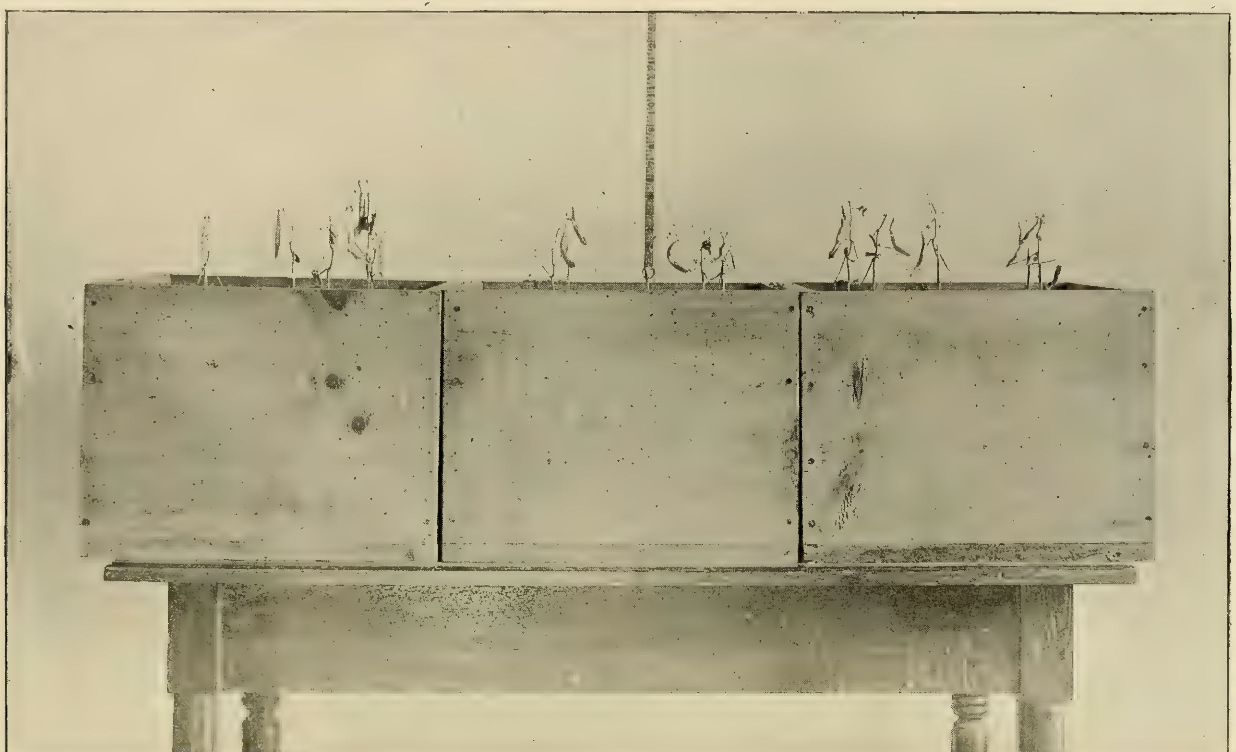
EXPERIMENT WITH BEANS.

Set.	Manure per box.	No. of box.	Total crop.	Beans.
I D ...	Nitrate of soda, 8.5 grams, and muriate of potash, 2.6 grams.	1	6 grams	1 gram
		2	6 grams	1 gram
		3	5 grams	1 gram
		Total..	17 grams	3 grams
II D....	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and South Carolina rock, 17.0 grams.	1	6 grams	1 gram
		2	7 grams	1.5 gram
		3	6 grams	1.5 gram
		Total..	19 grams	4.0 grams
III D ..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and acidulated South Carolina rock, 28.5 grams.	1	25 grams	10 grams
		2	29 grams	12 grams
		3	21 grams	9 grams
		Total..	75 grams	31 grams

Dry matter.

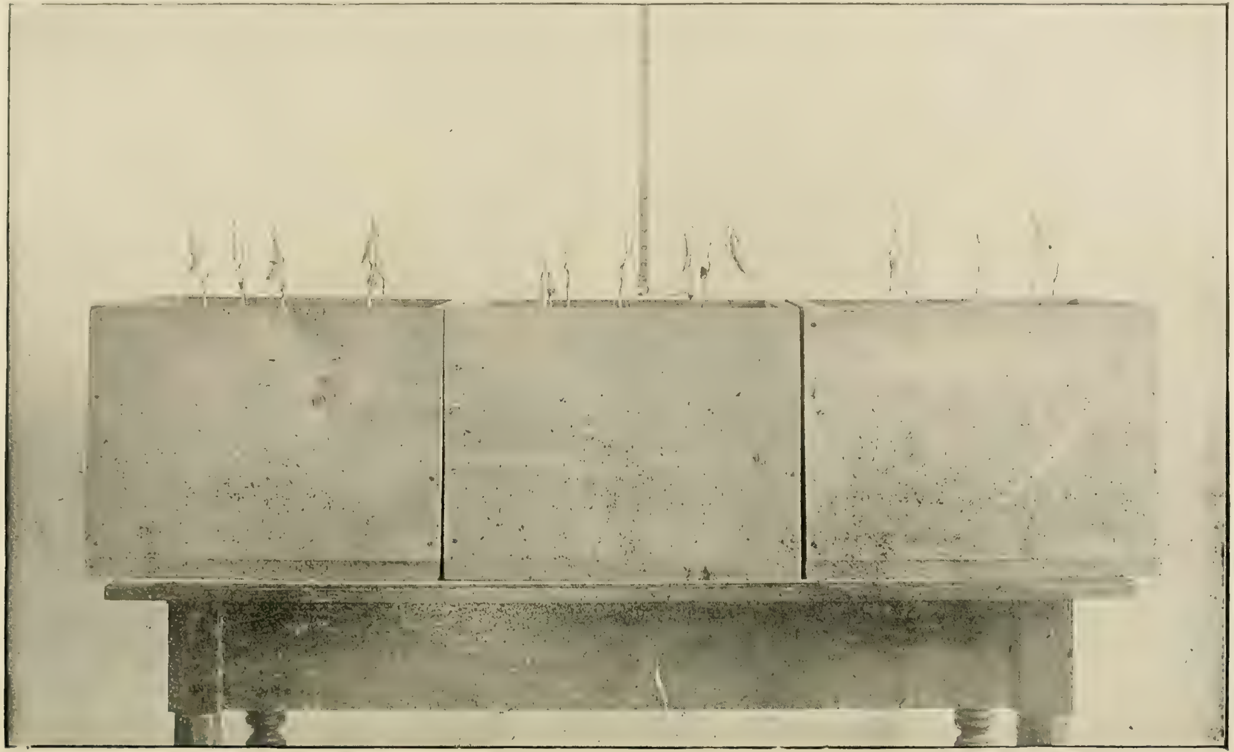
Set I D	15.7 grams
Set II D	17.4 grams
Set III D	69.8 grams

PLATE I. D.



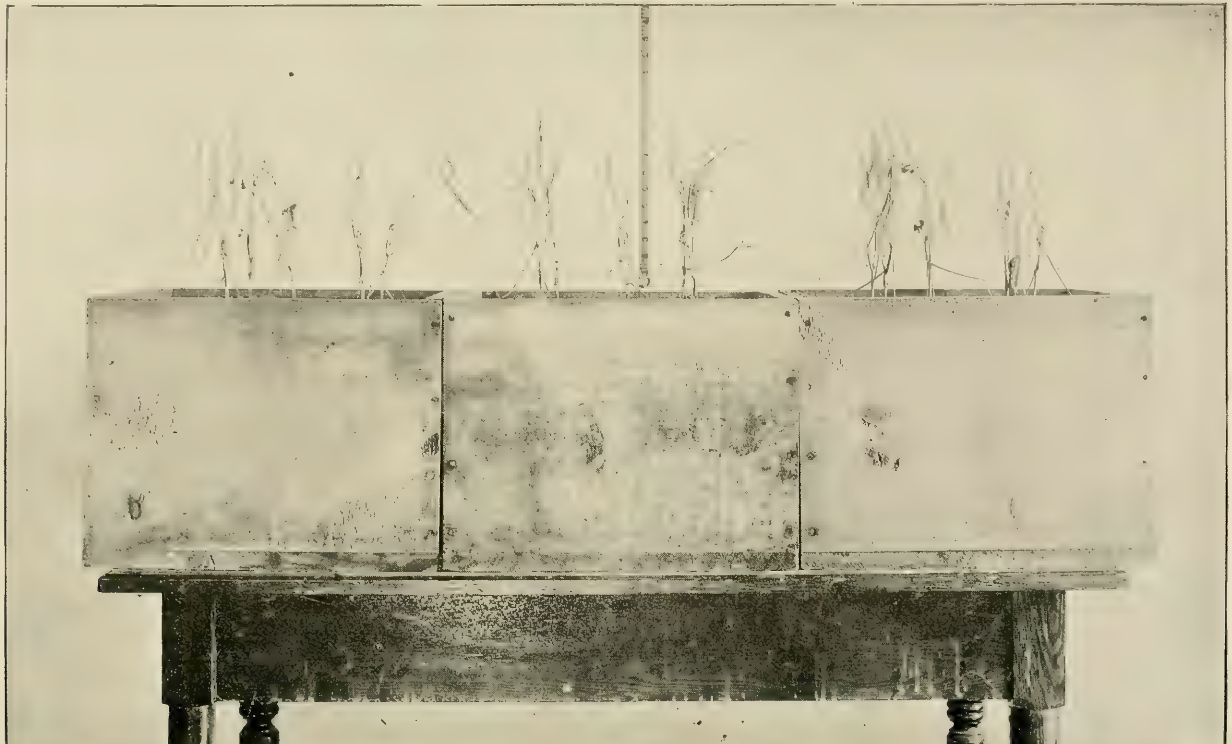
CROP, BEANS.

Manure,—Nitrate of Soda, Muriate of Potash.



CROP, BEANS.

Manure,—Nitrate of Soda, Muriate of Potash, S. C. Rock Phosphate.

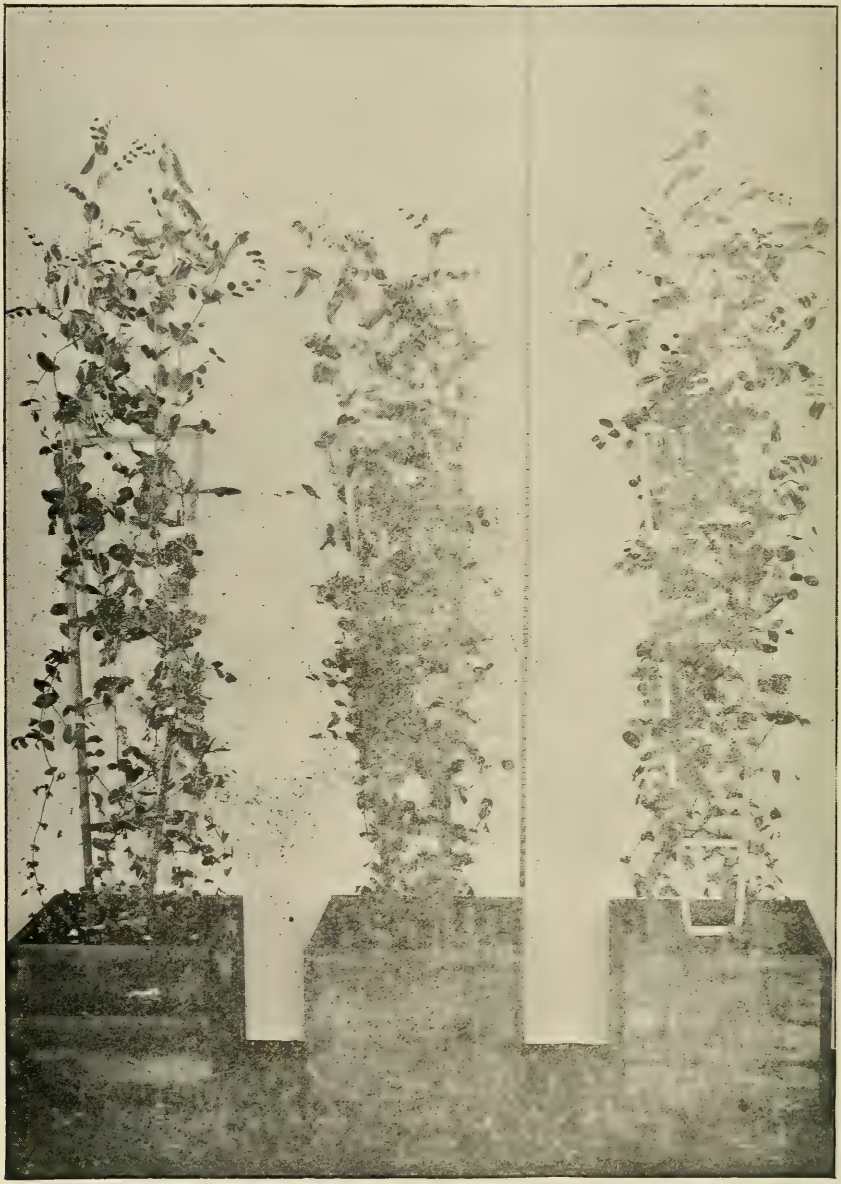


CROP, BEANS.

Manure,—Nitrate of Soda, Muriate of Potash, Acidulated S. C. Rock Phosphate.

CROP, PEAS.

Manure,—Nitrate of Soda, Muriate of Potash.



CROP, PEAS.

Manure,—Nitrate of Soda, Muriate of Potash, S. C. Rock Phosphate.

CROP, PEAS.

Manure,—Nitrate of Soda, Muriate of Potash, Acidulated S. C. Rock Phosphate.

TABLE V.

EXPERIMENT WITH PEAS.

Set.	Manure per box.	No. of box.	Total crop.	Peas in pod.
I E..	Nitrate of soda, 8.5 grams, and muriate of potash, 2.6 grams.	1	35 grams	7 grams
		2	41 grams	11 grams
		3	45 grams	14 grams
		Total..	121 grams	32 grams
II E..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and South Carolina rock, 17.0 grams.	1	73 grams	16 grams
		2	68 grams	17 grams
		3	70 grams	17 grams
		Total..	221 grams	50 grams
III E..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and acidulated South Carolina rock, 28.5 grams.	1	83 grams	16 grams
		2	78 grams	17 grams
		3	84 grams	18 grams
		Total..	245 grams	51 grams

Dry matter.

Set I E.. .... 112.7 grams
Set II E.. 196.7 grams
Set III E.. .... 228.6 grams

TABLE VI.

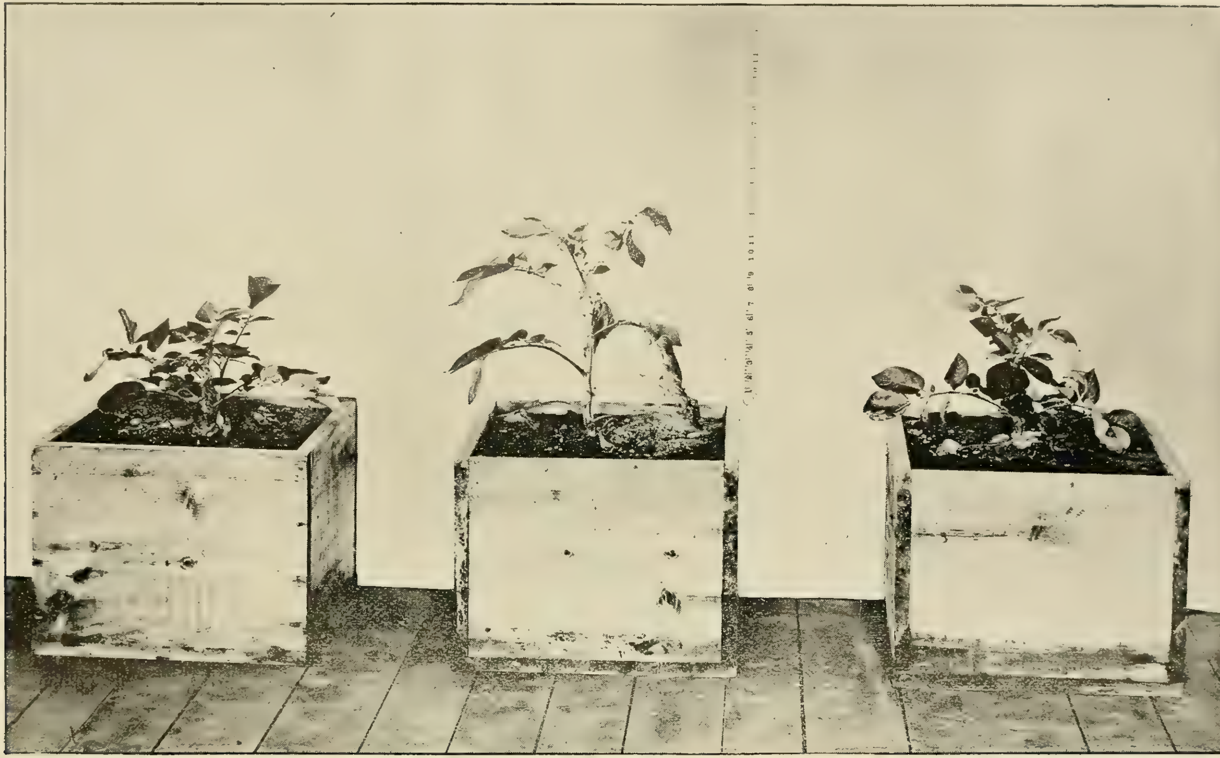
EXPERIMENT WITH POTATOES.

Set.	Manure per box.	No. of box.	Tubers.
I F..	Nitrate of soda, 8.5 grams, and muriate of potash, 2.6 grams.	1	162 grams
		2	170 grams
		3	195 grams
		Total..	527 grams
II F..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and South Carolina rock, 17.0 grams.	1	211 grams
		2	177 grams
		3	152 grams
		Total..	540 grams
III F..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and acidulated South Carolina rock, 28.5 grams.	1	326 grams
		2	321 grams
		3	361 grams
		Total..	1008 grams

Dry matter, including tops.

Set I F .... 113.3 grams
Set II F .... 114.6 grams
Set III F .... 223.6 grams

PLATE I. F.



CROP, POTATOES.

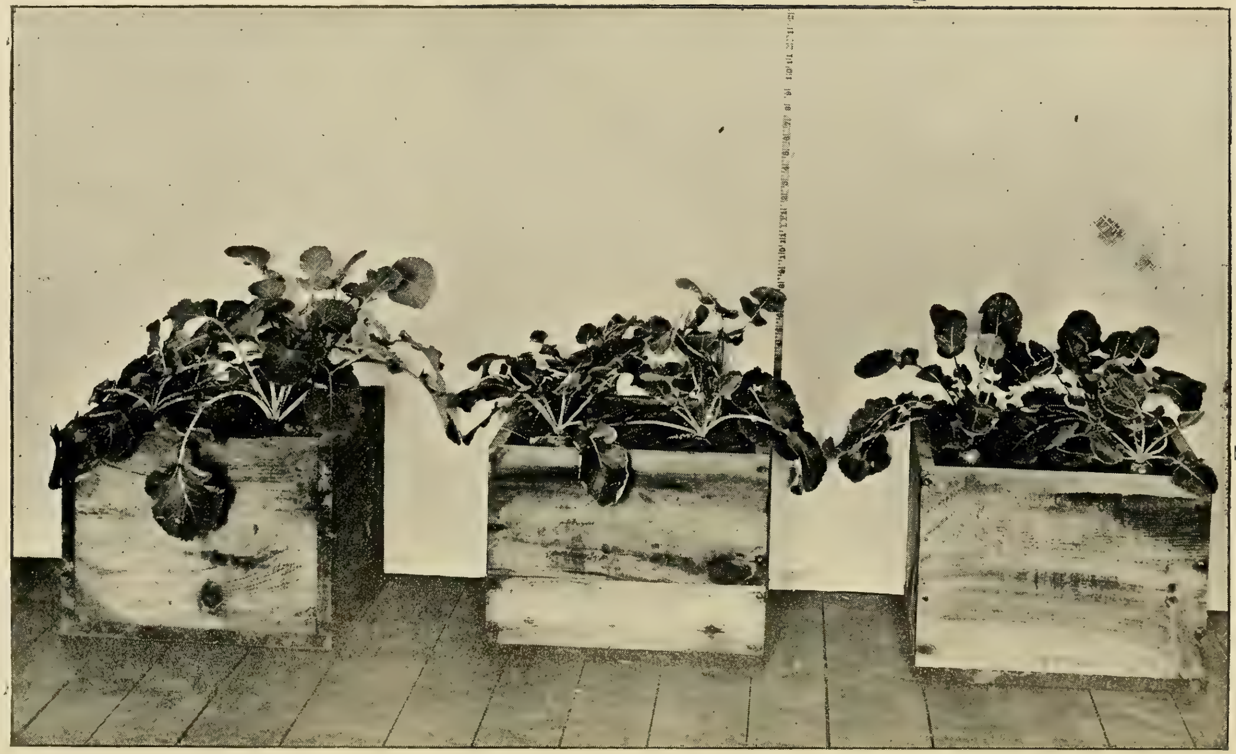
Manure,—Nitrate of Soda, Muriate of Potash.

CROP, POTATOES.

Manure,—Nitrate of Soda, Muriate of Potash, S. C. Rock Phosphate.

CROP, POTATOES.

Manure,—Nitrate of Soda, Muriate of Potash, Acidulated S. C. Rock Phosphate.



CROP, TURNIPS.

Manure,—Nitrate of Soda, Muriate of Potash.

CROP, TURNIPS.

Manure,—Nitrate of Soda, Muriate of Potash, S. C. Rock Phosphate.

CROP, TURNIPS.

Manure,—Nitrate of Soda, Muriate of Potash, Acidulated S. C. Rock Phosphate.

TABLE VII.

EXPERIMENT WITH TURNIPS.

Set.	Manure per box.	No. of box.	Total crop.	Roots.
I G..	Nitrate of soda, 8.5 grams, and muriate of potash, 2.6 grams.	1	398 grams	249 grams
		2	358 grams	233 grams
		3	542 grams	340 grams
		Total..	1298 grams	822 grams
II G..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and South Carolina rock, 17.0 grams.	1	914 grams	504 grams
		2	907 grams	616 grams
		3	947 grams	571 grams
		Total..	2768 grams	1691 grams
III G..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and acidulated South Carolina rock, 28.5 grams.	1	1055 grams	600 grams
		2	819 grams	406 grams
		3	925 grams	438 grams
		Total..	2799 grams	1444 grams

Dry matter.

Set I G .... 154.4 grams
Set II G .... 304.1 grams
Set III G .... 270.4 grams

The following table gives a partial chemical analysis of the total crop produced in each set of boxes, calculated on the water free substance.

TABLE VIII.

ANALYSIS OF ENTIRE CROP CALCULATED TO A WATER FREE BASIS.

	Nitrogen. N.—%.	Ash—%.	Sand and silica—%.	Potash K_2O—%.	Soda Na_2O—%.	Iron and alumina Fl_2O_3 Al_2O_3—%.	Phosphoric acid P_2O_5—%.	Sulphuric acid SO_3—%.	Chlorine Cl—%.
Wheat, Set I A.	1.36	4.19	1.23	1.37	.08	.24	.14	.14	.36
II A.	1.34	4.05	1.27	1.29	.13	.21	.21	.17	.34
III A.	1.28	4.87	1.95	1.23	.07	.31	.39	.25	.30
Barley, Set I B.	1.65	8.19	.60	3.13	.49	.27	.20	.14	2.24
II B.	1.48	7.61	1.18	2.71	.44	.29	.19	.20	1.76
III B.	1.57	9.23	.83	2.33	1.62	.14	.29	.40	2.60
Corn, Set I C.	1.55	9.33	5.03	1.35	.05	–	.21	.16	.20
II C.	1.49	6.85	3.31	1.31	.08	.38	.27	.17	.21
III C.	0.84	5.40	1.47	1.79	.10	.21	.29	.19	.49
Beans, Set I D.	3.75	19.23	9.63	1.98	.16	–	.27	.23	
II D.	3.65	18.50	8.99	1.92	.18	–	.31	.27	
III D.	2.80	12.43	4.52	2.16	.07	.49	.41	.26	.59
Peas, Set I E.	2.52	8.34	.76	2.03	.28	.17	.30	.18	.91
II E.	2.37	9.57	1.17	2.26	.33	.37	.30	.20	.98
III E.	2.19	9.05	.71	2.23	.34	.61	.28	.30	1.03
Potatoes, Set I F.	1.69	11.46	5.88	2.79	.11	.55	.28	.23	.45
II F.	2.02	10.62	4.28	2.95	.14	.47	.29	.32	.51
III F.	2.03	11.94	4.34	3.49	.21	.39	.40	.29	.69
Turnips, Set I G.	2.87	12.30	1.03	3.22	1.03	.25	.48	.20	1.38
II G.	2.75	12.50	1.79	3.18	1.62	.23	.70	.40	1.28
III G.	3.37	13.33	1.01	3.60	1.89	.22	.76	1.20	1.22

While it may not be desirable to draw definite conclusions from so small an amount of data as is furnished by the above described experiments, there are some points which under the conditions of these experiments the results appear to bring out sharply.

1st. Different crops showed a decided difference in their powers of obtaining phosphoric acid from crude, finely ground South Carolina rock. Wheat, barley, corn, peas and turnips apparently appropriated the insoluble phosphoric acid from this source with greater or less ease, while beans and potatoes derived no benefit from it.

2d. The greatest practical advantage derived from the use of fine-ground South Carolina rock was with the turnips. With this crop a larger weight of dry matter and also a larger weight of fresh roots was obtained with insoluble phosphoric acid from the finely ground South Carolina rock than with an equal amount of soluble phosphoric acid from acidulated South Carolina rock.

3d. The indications point to a profitable use of finely ground South Carolina rock as a manure for barley and peas as well as turnips.

4th. The acidulated South Carolina rock in these experiments apparently depressed the yield of grain with barley while largely increasing the amount of straw. With wheat both grain and straw were largely increased and in about the same proportion.

ANALYSES OF CATTLE FOODS.

W. H. Jordan, J. M. Bartlett, L. H. Merrill.

Note—The experiments in connection with which these analyses were made were planned largely by the Station Director. The analyses were entirely executed by the Station chemists. The Director is responsible for this discussion of the results.

It seems proper, because of certain views now held by agricultural chemists, that the following statement of the analyses of various cattle foods should be accompanied by explanations.

The opinion is now frequently expressed that to continue the analysis of our common cattle foods after the existing usual methods, simply for the sake of analysis, is largely a waste of time. This opinion is undoubtedly correct, and for the following reasons: 1st. Enough analyses have been made to establish the average composition of our common feeding stuffs as closely as is practicable or useful. Additional analyses will change the general averages very little.

2nd. Existing methods of food analysis are furnishing no new information about food compounds and are entirely inadequate to

aid in solving the problems in animal nutrition which now most urgently demand consideration.

There is an increasing need for a more intimate study of the properties of the individual compounds of cattle foods and their relation to nutritive processes.

Nevertheless, analyses of the foods involved in experimental work even by our confessedly unsatisfactory methods, are both necessary and useful, because they disclose certain facts which are fundamental conditions, and a knowledge of which is essential to successful plans and to any well grounded conclusions.

The analyses herewith reported have nearly all been occasioned by experimental work either in studying crop production or along the line of animal nutrition. However, some attempt has been made to step outside the beaten path by endeavoring to ascertain the amount present of those carbohydrates whose properties and functions are to a large degree understood. Certain sugars and the starchs are among our best known vegetable compounds, not only as to their constitution but also as to their offices in the animal body. We have every reason to regard them as the most valuable of the nutrients usually classed under the term "nitrogen-free-extract," and it is reasonable to believe that the nutritive value of this nitrogen-free-extract varies materially according as it contains largely such compounds as sucrose, glucose and starch, which are entirely digestible and directly useful, or is almost wholly made up of bodies of which we have scanty knowledge, the little we do know not being favorable to their efficiency as food. Therefore in the experiments which this Station has made with the corn crop, not only have the regular analyses been performed, but the amounts of sugars and starch have been ascertained as closely as existing methods would allow.

THE COMPOSITION OF FODDERS AND SILAGE FROM THE CORN (MAIZE) PLANT.

The analyses which appear below have been made during the past three years in connection with experiments in the value of the corn plant as a source of cattle food. They have been necessary in order to know the amount and general character of the dry matter produced, and have been required in the digestion and feeding experiments.

TABLE IX.

COMPOSITION OF CORN FODDER AND CORN SILAGE FROM CORN GROWN ON THE STATION EXPERIMENTAL PLATS.

	Parts in 100 of the Green or Air-Dry Material.						Parts in 100 of the Water-Free Material.				
	Water.	Ash.	Protein—Nx6.25.	Fiber.	Nitrogen-free-extract.	Fat.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Crop of 1891.											
CXLVII—Southern Corn, large white, immature, no ears	86.48	.99	1.70	4.33	6.22	.28	7.31	12.25	32.06	46.32	2.06
CXLVI—Maine Field Corn, mature, kernels glazed	86.48	.84	1.70	4.13	6.57	.28	6.25	12.22	30.56	48.95	2.02
CXLVIII—Sweet Corn, mature	86.19	.87	1.92	3.91	6.73	.45	6.29	13.96	27.74	48.72	3.29
Crop of 1892.											
CLX—Southern Corn, large white, immature, no ears	85.33	1.21	1.78	4.03	7.37	.28	8.24	12.14	27.45	50.22	1.95
CLXI—Southern Corn, large white, immature, no ears	85.85	1.04	1.75	4.08	6.93	.36	7.38	12.24	28.86	48.96	2.56
CLXII—Maine Field Corn, mature, kernels partly glazed	79.11	1.25	2.26	3.86	12.84	.68	5.98	10.83	18.48	61.46	3.25
CLXIII—Maine Field Corn, mature, kernels partly glazed	81.38	1.10	2.15	3.92	10.93	.52	5.89	11.53	21.04	58.74	2.80
CLXX—Southern Corn silage, from CLX	86.50	1.11	1.69	4.03	6.30	.37	8.21	12.52	29.85	46.64	2.78
CLXXVI—Southern Corn silage, from CLXI	83.80	1.03	2.60	4.89	6.94	.74	6.35	16.02	30.17	42.84	4.62
CLXXI—Maine Field Corn silage, from CLXII	77.70	1.28	2.25	4.73	13.23	.81	5.74	10.10	21.21	59.31	3.64
CLXXIII—Maine Field Corn silage, from CLXIII	79.60	.97	2.09	4.72	11.81	.81	4.74	10.23	23.13	57.91	3.99
Crop of 1893.											
CCXXIV—Southern Corn, large white, immature, no ears	84.55	1.29	1.57	4.35	7.90	.34	8.34	10.16	28.18	51.10	2.22
CCXXV—Southern Corn, large white, immature, no ears	83.42	1.17	2.04	4.36	8.62	.39	7.06	12.32	26.31	51.94	2.37
CCXXVI—Maine Field Corn, mature, kernels partly glazed	80.51	1.25	2.37	4.10	11.27	.50	6.41	12.16	21.06	57.81	2.56
CCXXVII—Maine Field Corn, cut August 15th, immature, no kernels formed	88.29	1.09	1.75	3.10	5.46	.30	9.33	14.96	26.51	46.60	2.60
CCXXVIII—Maine Field Corn, cut August 28th	82.50	1.14	2.05	4.08	9.71	.52	6.50	11.74	23.31	55.50	2.95
CCXXIX—Maine Field Corn, cut September 4th	80.45	1.21	2.22	3.85	11.68	.59	6.21	11.38	19.67	59.74	3.00
CCXXX—Maine Field Corn, cut September 12th	76.83	1.29	2.22	4.48	14.50	.68	5.58	9.57	19.33	62.52	3.00
CCXXXI—Maine Field Corn, cut September 21st, mature, kernels partly glazed, rapidly dried	74.66	1.50	2.34	4.71	16.04	.75	5.91	9.23	18.60	63.30	2.96
CCXXXII—Maine Field Corn, same as CCXXXI, dried slowly, without heat	78.24	1.55	2.29	4.67	12.63	.62	7.14	10.54	21.39	58.08	2.85

The above mass of figures give information on two points which are worthy of consideration by Maine farmers; viz: (1) The comparative composition of the large Southern varieties of corn, which are so often grown in Maine for fodder purposes, and the Northern field corn such as matures in Maine, which is regarded by many as the more valuable variety for use in this State.

(2) The effect of the degree of maturity of the corn plant upon its composition. The large varieties of corn *must* be cut in this State when very immature, and our own small field corn *may* be cut in any stage of maturity. What is the effect of immaturity upon the value of the plant as a food?

THE COMPARATIVE COMPOSITION OF THE LARGE SOUTHERN CORN AND THE SMALLER MAINE FIELD CORN, THE FORMER IMMATURE WHEN CUT AND THE LATTER MATURE.

Observations on these two varieties of corn have been made for five years and in the averages given below, there are included analyses already published in the reports of this Station for 1889 and 1891. The analyses for the years 1888, 1890 and 1891 are averaged separately from those of 1892 and 1893 for the reason that the samples for the first three years were obtained in a way that probably allowed a material change in their composition. In 1888, 1890 and 1891 several hundred pounds of the green plant were stored under cover in such a manner as to partially air-dry without any apparent fermentation or decay, and the fodder was not analyzed until it had stood in this condition for several months, when it was used for digestion experiments. Doubtless these fodders had suffered changes incident to the slow drying of large succulent plants, even under the most favorable conditions. In 1892 and 1893, immediately upon cutting in the field, several hundred pounds of the perfectly fresh material were finely chopped and crushed, a portion of which was rapidly dried in a steam closet. Facts given later indicate that the latter method of procedure much more fully preserved the original condition of the plant than the former, and so the analyses for the last two years are the more trustworthy as a means of ascertaining the nature of the growth which actually occurred.

It should be remarked, also that while the crops of Maine field corn must be regarded as mature in 1888, 1889 and 1890, they were much more heavily eared in 1892 and 1893.

TABLE X.

RELATIVE COMPOSITION OF TWO VARIETIES OF CORN (GREEN).

	In 100 parts fresh substance.						
Crops of 1888, 1890 and 1891—Average.	Water.	Dry substance.	Ash.	Protein N × 6.25.	Fiber.	Nitrogen-free-extract	Fat.
Southern Corn, immature	86.41	13.59	1.05	1.61	4.28	6.30	.35
Maine Field Corn, mature	84.43	15.57	1.13	1.92	4.39	7.73	.40
Excess in Field Corn......	–	1.98	.08	.31	.11	1.43	.05
Crops of 1892 and 1893—Average.							
Southern Corn, immature...........	84.80	15.20	1.18	1.78	4.20	7.70	.34
Maine Field Corn, mature	78.91	21.09	1.28	2.28	4.15	12.77	.61
Excess in Field Corn	–	5.89	.10	.50	—.05	5.07	.27

It appears from these averages that under the conditions existing in Maine, which require the cutting of the large varieties of corn in an immature state, the Maine field corn which reaches maturity, contains the larger percentage of dry matter. This is true especially of the years 1892 and 1893, when the latter crop was more perfectly developed. Again, the excess of dry matter in the Maine field corn consists almost wholly of the non-nitrogenous compounds classed under the head of nitrogen-free-extract. The characteristic differences in the composition of the dry substance of the two varieties of corn are more clearly seen by a comparison in the water-free condition.

TABLE XI.

COMPOSITION OF THE WATER-FREE SUBSTANCE OF TWO VARIETIES OF CORN.

	In 100 parts water-free substance.				
Average for 1892 and 1893.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Southern Corn, immature	7.76	11.72	27.70	50.54	2.28
Maine Field Corn, mature	6.05	10.94	19.79	60.33	2.89
Differences.................................. ...	+.71	+.78	+7.91	—9.89	—.61

The dry substance of the larger and immature corn contains more ash protein and fiber and less nitrogen-free-extract and fat: The much larger percentage of fiber and greatly less percentage of nitrogen-free-extract are the noteworthy differences.

THE INFLUENCE OF MATURITY UPON THE COMPOSITION OF THE CORN PLANT.

The figures above cited compare two varieties of corn in unlike stages of maturity and show important differences in composition. Is this a question of maturity or of variety? In order to obtain testimony on this point, in 1893 field No. 1 of Maine field corn was cut in five different lots, ranging in times of cutting from August 15th to September 21st, and in stage of growth from the early formation of the ear to full maturity. The analyses of samples from these different cuttings appear in Table 1 but are reproduced below.

TABLE XII.

COMPOSITION OF CORN CUT AT DIFFERENT PERIODS OF GROWTH.

	In 100 parts fresh substance.						
	Water.	Dry substance.	Ash.	Protein N × 6.25.	Fiber.	Nitrogen-free-extract.	Fat.
Maine Field Corn, cut August 15th..	88.29	11.71	1.09	1.75	3.10	5.46	.30
August 28th..	82.50	17.50	1.14	2.05	4.08	9.71	.52
Sept. 4th	80.45	19.55	1.21	2.22	3.85	11.68	.59
Sept. 12th....	76.83	23.17	1.29	2.22	4.48	14.50	.68
Sept. 21st	74.66	25.34	1.50	2.34	4.71	16.04	.75

The immature and mature corn differ in the following essential particulars :

(1) The mature corn is less watery : i. e. it contains a much larger percentage of dry substance. During the thirty days before the mature crop was harvested there was a continuous and large increase in the percentage of dry matter. It will appear later that this was due to an actual growth of dry matter, rather to a drying out of the water with a diminished weight of crop.

(2) This increase was most largely from the growth of compounds classed as nitrogen-free-extract, such as starch, sugar and allied bodies.

This is most clearly shown by the arrangement of figures in Table 13 :

TABLE XIII.

RELATION OF DIFFERENT CLASSES OF COMPOUNDS IN CORN CUT AT DIFFERENT PERIODS OF GROWTH.

	In 100 pounds of green corn as cut.		
	Pounds of dry matter.	Pounds of nitrogen-free-extract.	Pounds of all compounds other than nitrogen-free-extract.
Lot cut August 15th, very immature	11.71	5.46	6.25
August 28th	17.50	9.71	7.79
September 4th	19.55	11.68	7.87
September 12th	23.17	14.50	8.67
September 21st, mature	25.34	16.04	9.30

Lot cut August 15th ....Other compounds: Nitrogen-free-extract: : 100: 87.3
Lot cut August 28th ....Other compounds: Nitrogen-free-extract: : 100:124.6
Lot cut September 4th ....Other compounds: Nitrogen-free-extract: : 100:148.4
Lot cut September 12th ....Other compounds: Nitrogen-free-extract: : 100:167.2
Lot cut September 21st..... ...Other compounds: Nitrogen-free-extract: : 100:175.4

The answer to our question must be, then, that the changes which are shown in the experiment with Maine field corn to be due to increasing maturity are those which exactly explain the differences between the two varieties of corn compared.

It seems impossible to avoid the conclusion that the inferiority of the larger Southern corn, when compared pound for pound with our smaller Northern variety, is caused in part, at least, by the necessity of harvesting it in an immature condition.

TO THE FORMATION OF WHAT COMPOUNDS IS DUE THE LARGE RELATIVE INCREASE OF NITROGEN-FREE-EXTRACT AS THE CORN PLANT APPROACHES MATURITY.

As before stated an attempt has been made to extend these analyses beyond the usual routine. This has been in the way of determinations of the sugars and starch, in order to learn the extent to which these more valuable carbohydrates are present in the corn plant, and the influence of certain conditions upon their amount.

It is believed that the percentages of starch given in this connection much more nearly represent the actual amounts present in the fodders analyzed than when the ordinary method of analysis is followed.*

The method of starch determination generally used is to treat the substance for a given period with hot dilute acid, which results in the conversion not only of starch but partly, at least, of cellulose and gums into glucose. The amount of this sugar is ascertained by its action in precipitating copper oxide from Fehling's solution and all the sugar thus found is assumed to come from starch alone, which is far from the truth. If we did not have reason to believe that starch is greatly superior in food value to the cellulose, gums, etc., which suffer hydrolysis by the action of mineral acids, this assumption would be less fatal to correct conclusions. But so long as starch appears to be entirely digestible, while these other bodies certainly are not, and so long as there is good reason for regarding digested cellulose and gums as less efficient nutrients than digested starch, it is certainly nothing less than absurd to go on assuming that all the sugar produced when vegetable substances are treated with mineral acids comes from starch. The method used here was the conversion of the starch into water-soluble compounds through the action of a ferment known as diastase In the case of a few samples the acid and diastase methods have been compared.

TABLE XIV.

COMPARISON OF PERCENTAGES OF STARCH AS FOUND BY THE ACID AND BY THE DIASTASE METHODS.

	In 100 parts water-free substance.			
	Total nitrogen-free-extract.	Starch, by diastase method.	"Starch," by acid method.	Excess, by acid method.
CLX—Southern Corn, immature, no ears, Field I....	50.22	2.03	14.98	12.95
CLXI—Southern Corn, immature, no ears, Field II..	48.96	2.24	15.27	13.03
CLXII—Maine Field Corn, mature, Field I...........	61.64	18.58	30.32	11.74
CLXIII—Maine Field Corn, mature, Field II...... ...	58.74	12.66	23.97	11.31
CLXX—Southern Corn silage, from CLX.........	46.64	3.70	14.63	10.93
CLXXVI—Southern Corn silage, from CLXI...... ...	42.84	3.56	14.90	11.35
CLXXI—Maine Field Corn silage, from CLXII.......	59.31	18.32	29.50	11.18
CLXXIII—Maine Field Corn silage, from CLXIII ...	57.91	17.43	30.00	12.57

*Mr. Bartlett describes his methods on subsequent pages of this report.

The percentages of "starch" by the acid method are greatly but quite uniformly larger than by the diastase method, this excess ranging between 10.93 to 13.03 per cent of the total substance of the plant, or from 24.5 per cent to 31 per cent of the nitrogen-free-extract.

This uniformity of difference in the two methods, while proving nothing, is certainly favorable to confidence in the approximate accuracy of the diastase method, especially where the results range from 2 to 18 per cent. If, for instance, the low percentages of starch in the case of samples CLX CLXI, CLXX and CLXXVI and the high percentages in the other samples were due to the less perfect extraction of starch in the former, this fact would be disclosed by an increased excess with the acid method. As a matter of fact the acid method shows an excess only .36 per cent larger with the samples low in starch by the diastase methed. Moreover, Mr. Bartlett's report shows that an increase in the time of the action of the diastase beyond a certain limit failed to produce higher results, which makes it improbable that an undissolved residue of starch still existed.

The percentages of sugar and starch in all the samples analyzed in 1892 and 1893 appear in Table XV. In Table XVI are the averages for the immature Southern Corn and the mature Maine Field Corn.

TABLE XV.

PERCENTAGES OF SUGARS AND STARCH IN THE WHOLE CORN PLANT.

Crop of 1892.	Parts in 100 of water-free substance.				Parts of sugar & starch in 100 nitrogen-free-extract.
	Sugar.	Starch.	Total sugar and starch.	Total nitrogen-free-extract.	
Southern Corn, immature .... Field 1..	13.03	2.03	15.06	50.22	30.0
Field 2..	10.60	2.24	12.84	48.96	26.2
Maine Field Corn, mature ....Field 1..	11 88	18.58	30.46	61.46	49.5
Field 2..	11.40	12.66	24.06	58.74	40.9
Southern Corn, silage.......... from Field 1..	–	3.70	3.70	46.64	7.9
Field 2..	–	3.56	3.56	42.84	8.3
Maine Field Corn, silage . .....from Field 1..	–	18.32	18.32	59.31	30.9
Field 2..	–	17.43	17.43	57.91	30.1
Crop of 1893.					
Southern Corn, immature ....Field 1..	13.34	–	13.34	51.10	26.1
Field 2..	14.45	–	14.45	51.94	27.8
Maine Field Corn, mature ....Field 2..	13.50	9.48	22.98	57.81	39.7
Maine Field Corn, very immature, cut Aug. 15th ....Field 1..	11.70	–	11.70	46.60	25.1
Maine Field Corn, cut Aug. 28th .....Field 1..	20.43	2.07	22.50	55.50	40.5
Sept. 4th ......Field 1..	20.60	4.89	25.49	59.74	42.7
Sept. 12th .....Field 1..	21.06	5.35	26.41	62.52	42.2
Maine Field Corn, mature, cut Sept. 21st ....Field 1..	16.50	15.37	31.87	63.30	50.3

TABLE XVI.

COMPARISON OF PERCENTAGES OF SUGARS AND STARCH IN THE DRY SUBSTANCE OF IMMATURE AND MATURE CORN PLANT.

	Parts in 100 of water-free substance.				Parts of sugars and starch in 100 parts of nitrogen-free-extract.
	Sugars.	Starch.	Total sugars and starch.	Total nitrogen-free-extract.	
Southern Corn, immature, no ears, four samples	12.85	1.07	13.92	50.55	27.5
Maine Field Corn, mature, full ears, four samples	13.32	14.02	27.34	60.33	45.3
Excess in the Maine Field Corn	.47	12.95	13.42	9.78	17.8

There is a constant and striking difference between the percentages of starch in the Southern corn and in the Maine field corn. They are much larger in the latter kind. This is due undoubtedly to greater maturity Only a small amount of starch appears to be deposited in the stalk and leaves, its rapid formation and storage in the plant apparently not beginning until the later development of the fruit or kernels. The analyses of Maine field corn in various stages show this fact very clearly. They also show that while a decrease in sugar occurred with the maturing of the ear, this was much less than the corresponding increase of starch, so that maturity shows a large excess over any other period of the more valuable carbohydrates.

There is, however, over four per cent less of sugar in the mature corn than at any period since the first one investigated. If the influence of maturity is in general to diminish the sugars present, less acidity of the silage would certainly result from the same cause. It appears, however, that there is not less, but rather more, sugar in the mature field corn than in the Southern corn, so that it is reasonable to expect, in these cases at least, fully as acid silage from the former variety.

THE EFFECT OF SLOW DRYING UPON THE COMPOSITION OF A SAMPLE OF A SUCCULENT PLANT.

It must be well known to chemists that in order to secure a sample of a watery plant like green corn, which shall correctly represent its composition, it is necessary that this sample be dried as promptly and as rapidly as possible with a reasonable degree of heat.

One or two experiences at this Station serve, however, to forcibly illustrate this fact.

At the time of cutting the 1893 crop of Maine field corn at different stages of growth it was desired to save some of the first and last cuttings for digestion trials. No means being available for drying the needed quantity by artificial heat, five hundred pounds of each cutting were finely chopped and spread very thinly on a scaffold in the Station barn, over at least six hundred square feet of surface. The doors and windows of the barn were open, which allowed a free circulation of air, and under these conditions the material was allowed to become air-dry. This was accomplished with no apparent moulding or fermentation. Before spreading the last cutting, the chopped material was very thoroughly mixed and a smaller sample of about twenty pounds was selected and taken at once to the Station laboratory, where it was rapidly dried in a steam closet. The following are the analyses of the slowly and rapidly dried samples.

TABLE XVII.

INFLUENCE OF METHOD OF DRYING UPON COMPOSITION OF CORN PLANT.

	In 100 parts fresh corn as cut.								
	Water.	Dry substance.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.	Sugars.	Starch.
Rapidly dried sample	74.66	25.34	1.50	2.34	4.71	16.04	.75	4.18	3.89
Slowly dried sample........	78.24	21.76	1.55	2.29	4.67	12.63	.62	1.72	3.66
Difference		3.58	.05	.05	.04	3.41	.13	2.46	.23

It seems that for each hundred pounds of green corn 3.58 per cent of dry matter was lost in the process of slow drying under the most favorable circumstances. This was 14.13 per cent of the total dry matter in the fresh plant, which means that of each hundred pounds of dry substance originally in the plant only 85.87 pounds were saved.

It is interesting to note that this loss falls almost entirely on the nitrogen-free extract, or carbohydrates, more than two-thirds of it being actually accounted for by the diminished percentage of sugars.

SUMMARY.

(1) The large varieties of corn which mature in the West and South must be harvested in Maine in a very immature condition, while the smaller Flint varieties may usually be allowed to stand until maturity.

(2) Under these conditions the smaller varieties of Flint corn had, when harvested, a much higher percentage of dry matter than the large immature Dent corn.

(3) The excess of dry matter in the Maine field corn consisted almost wholly of nitrogen-free-extract or the non-nitrogenous part of the plant.

(4) The dry matter of the large immature Dent corn contained .78 per cent more protein, 7.91 per cent more fiber and 9.89 per cent less nitrogen-free-extract.

(5) The development of the Flint corn to maturity caused a large relative production of nitrogen free extract as compared with an earlier stage of growth When in the silking stage the nitrogen-free-extract made up about 47 per cent of the dry matter of the plant, but this proportion increased to 63 per cent at maturity.

(6) The mature corn contained much the larger proportion of the more valuable carbohydrates, the sugars and starch. The starch especially increased, changing in an average of four samples from 1 per cent to 14 per cent of the dry substance of the plant.

(7) It appears from facts previously known, and from observations made in connection with these analyses that the diastase method of determining starch gives more nearly accurate results than the acid method.

(8) A material loss of dry matter is likely to occur when green corn fodder is slowly dried even under the most favorable conditions.

METHODS OF DETERMINING SUGAR AND STARCH.

J. M. Bartlett.

Acid Method. The sugars are determined by the method described in Report Maine Experiment Station, 1888, page 207 and the acid method employed to extract starch was that given on page 208 of same report, except that a one per cent instead of a one-half per cent HCl solution was used.

Diastase Method. Four grams of the finely ground fodder are digested with 50 c. c. water on the steam-bath for one hour, and then 50 c. c. of a freshly prepared extract of malt are added. (The extract is made by placing fifty grams of powdered malt in a liter flask, filling to the mark with distilled water, and then after standing two hours with frequent shaking, the liquid is clarified by passing through a double filter.)

The digestion with the malt is carried on at a temperature of 65° C for four or five hours, which is sufficient time to bring the starch all into a soluble condition, no more being obtained by treating longer. This was shown by several trials. This liquid is then passed through a linen filter and the residue thoroughly washed with warm water, bringing the volume up to about 200 c. c. To complete the conversion of the starch to sugar, 20 c. c. of HCl (Sp. gr. 1.125) are now added and the whole digested on the steam-bath for three hours. After cooling, the liquid is neutralized with caustic potash, then four or five c. c. basic acetate of lead are added, the volume made up to the mark (200 c. c.) and filtered through a dry filter; 25 c. c. are then treated with Fehling solution, in the usual manner. If any lead remains in the solution, it must be removed with sulphurous acid before the Fehling solution is added.

DIGESTION EXPERIMENTS.

W. H. Jordan.

The digestion experiments reported herewith show the results of three seasons work in that direction. They have been conducted largely as one means of studying the food value of the corn crop for cattle and because of the number of times the observations have been repeated with reasonably uniform results, they furnish to the Maine farmer data that may be considered fairly reliable. It has been deemed better to allow these figures to accumulate until they should constitute a safe basis for general statements, rather than publish them in a disconnected way as obtained. This has been also the more desirable because these trials are chiefly only a part of a general investigation covering several years.

The animals used have in all instances been sheep. The trials have covered a period of twelve or thirteen days, during the last five of which the fæces have been collected. These experiments have been especially free of mishaps, such as refusal to eat the entire ration, impaired health of the animals, or loss of dung from the collecting bags.

It is recognized, of course, that certain conditions operate to limit the accuracy and definiteness of digestion trials, such as individuality of animals, irregularity of excretion, the presence in the fæces of metabolic products which are not properly a part of the undigested food residues, and, in general, the present limitations of analytical methods, which do not admit of a satisfactory study of the digestibility of the various individual compounds of feeding stuffs. The first two conditions are overcome largely by averaging results simultaneously obtained with several animals, and it is hoped that future investigations will remove the difficulties caused by the existing lack of knowledge.

DIGESTIBILITY OF CORN FODDERS.

The various materials coming from the corn plant which have been made the subject of digestion trials not heretofore reported are as follows:

CXLVII. Southern Corn Fodder. Whole plant. Crop of 1891. Cut when the corn was immature, the formation of ears not having

begun. Partially air-dried under cover, without showing any mould or decay.

CXLVI. Field Corn Fodder. Whole plant. Crop of 1891. Cut after the ears had become fully developed, the kernels being partially glazed. Partially air-dried under cover, without showing mould or decay.

CXLVIII. Sweet Corn Fodder. Whole plant. Crop of 1891. Cut after the ears had fully developed. Partially air-dried under cover, without showing mould or decay.

CLXX. Southern Corn Silage. Whole plant. Crop of 1892. Cut when immature, the formation of ears having merely begun on some stalks. Chopped and packed in silo. Silage good quality in appearance and flavor.

CLXXI. Field Corn Silage. Whole plant. Crop of 1892. Field No. 1. An abundant crop, heavily eared. Cut after ears had fully developed, the kernels being partially glazed. Chopped for silo. Silage very fine in appearance and flavor.

CLXXIII. Field Corn Silage. Whole plant. Crop of 1892. Field No. 2. A good crop well eared. Cut after the ears had fully developed, the kernels being partially glazed. Silage very fine in appearance and quality.

CCXXVII. Field Corn Fodder. Whole plant. Crop of 1893. Field No. I. Cut August 15th when formation of ears had only fairly begun. Chopped finely, spread very thinly on a scaffold and dried without any apparent fermentation.

CCXXXIII. Field Corn Fodder Whole plant. Crop of 1893. From same field as CCXXVII. Cut September 21st, after ears had fully developed and the the kernels were partially glazed. An abundant crop, heavily eared. Cut fine, spread very thinly on a scaffold and dried with no apparent fermentation.

The composition of the above named materials in the fresh and in the water-free condition is given on previous pages under the head of Analyses of Cattle Foods. Their composition at the time of using them in the digestion trials is stated below.

TABLE XVIII.

COMPOSITION OF FODDER MATERIALS AS FED IN DIGESTION EXPERIMENTS.

	Water.	Ash.	Protein.	Fiber.	Nitrogen free-extract.	Fat.
CXLVII Southern Corn fodder, partially air-dried	50.50	3.61	6.06	15.87	22.94	1.02
CXLVI Field Corn fodder, partially air-dried	33.24	4.17	8.16	20.40	32.65	1.38
CXLVIII Sweet Corn fodder, partially air-dried	39.30	3.82	8.47	16.85	29.57	2.00
CLXX Southern Corn silage	86.50	1.11	1.69	4.03	6.30	.37
CLXXI Field Corn silage	77.70	1.28	2.25	4.73	13.23	.81
CLXXIII Field Corn silage	79.60	.97	2.09	4.72	11.81	.81
CCXXVII Field Corn fodder, air-dry	17.53	7.69	12.34	21.86	38.44	2.14
CCXXXIII Field Corn fodder, air-dry	18.93	5.79	8.55	17.34	47.08	2.31

The digestion coefficients of the fodders and silages previously described, as determined by actual trials, appear below. The data and necessary calculations can be found on subsequent pages.

TABLE XIX.

DIGESTION COEFFICIENTS OF CORN FODDERS AND CORN SILAGES.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
CXLVII—Southern Corn fodder, 1891	61.3	62.8	43.1	63.4	65.7	61.	59.
CXLVI—Field Corn fodder, 1891	72.7	74.2	50.7	67.6	78.6	73.8	64.7
CXLVIII—Sweet Corn fodder, 1891	70.9	72.7	44.	71.5	74.6	73.1	77.
CLXX—Southern Corn silage, 1892	64.4	65.8	48.2	64.8	66.7	65.4	67.8
CLXXI—Field Corn silage, 1892	78.	80.2	41.3	68.	77.9	83.1	80.9
CLXXIII—Field Corn silage, 1892	76.	77.9	36.6	73.3	77.8	78.5	80.9
CCXXVII—Field Corn fodder, 1893	69.8	71.4	54.5	70.4	72.3	71.3	67.3
CCXXXIII—Field Corn Fodder, 1893	69.7	73.6	20.	68.6	70.7	76.7	73.7

THE DIGESTIBILITY OF CORN FODDER AND CORN SILAGE AS COMPARED WITH OTHER CATTLE FOODS.

During the past four years sixteen different samples of corn fodder and silage have been made the subject of thirty-seven digestion trials at the Maine Experiment Station. These trials have included three varieties of corn both as partially dried fodder and as silage, coming from four years crops excepting in the case of the sweet corn. Further repetition of this work ought not to be necessary in order to establish safe digestion co-efficients for use in Maine feeding practice. The averages of the entire number of trials are for each variety of corn as follows:

TABLE XX.

AVERAGE COEFFICIENTS OF DIGESTIBILITY AS FOUND AT THE MAINE EXPERIMENT STATION.

	Dry matter.	Organic matter.	Ash.	Protein N×6.25.	Fiber.	Nitrogen-free-extract.	Fat.
Southern Corn fodder, 3 samples, 6 trials	65.2	66.8	45.1	62.3	71.5	65.0	66.2
Southern Corn silage, 2 samples, 6 trials	63.8	66.0	31.5	55.7	70.2	65.5	66.5
Field Corn fodder, 4 samples, 9 trials	70.8	73.1	41.9	65.4	76.2	73.3	70.0
Field Corn silage, 3 samples, 8 trials	74.3	76.7	30.0	64.7	76.9	78.3	81.4
Sweet Corn fodder, 3 samples, 6 trials	67.1	69.7	35.6	64.1	73.8	68.2	76.9
Sweet Corn silage, 1 sample, 2 trials	68.1	70.1	31.9	54.0	71.1	71.8	83.5
Timothy hay (average 10 (Maine) samples)	57.0	58.0	37.0	48.0	53.0	63.0	57.0
Wheat bran, average 2 samples	59.0	63.0	-	76.0	-	66.0	73.0
Corn meal*	87.0	-	-	60.0	-	92.0	92.0

* General average.

These figures show beyond question that corn fodder well preserved and corn silage have a high digestibility as compared with hay. To this fact should be attributed in large measure, undoubtedly, the great favor with which the corn plant, as now preserved in the silo, is regarded by dairymen as milk producing food. What has been supposed by many to be due to the peculiar influence of

the fermentations in the silo, should more properly be credited to the superior food properties of the plant which the silo conserves so efficiently, and which would be equally valuable when preserved as completely in any other manner.

COMPARATIVE DIGESTIBILITY OF MAINE FIELD CORN AND THE LARGE SOUTHERN WHITE CORN.

There appears to be a marked difference in the digestibility of these two varieties of corn, which were grown under entirely similar conditions as to climate, location and manuring, the former being allowed to mature and the latter cut before silking. The following figures are sufficient evidence of this and show that the advantage is greatly with the smaller variety.

TABLE XXI.

COMPARATIVE DIGESTIBILITY OF TWO VARIETIES OF CORN.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Field Corn fodder and silage, 7 samples, 17 trials	72.3	74.6	36.8	65.1	76.5	75.5	74.9
Southern Corn fodder and silage, 5 samples, 12 trials	64.6	66.5	39.7	59.6	71.0	65.2	66.3
Difference in favor of the Field Corn	7.7	8.1	–	5.5	5.5	10.3	8.6

The observations on which the above comparison is based are too numerous and too nearly a unit in the evidence which they furnish to allow a chance of doubting the significance of the figures. It is certainly a matter of some importance to Maine farmers that the smaller variety of corn which matures in this latitude, should prove to be more digestible to the extent of about eight per cent of the total dry matter.

The nitrogen-free-extract appears to show a greater difference of digestibility than any other portion of the plant and it is here that we must look for at least a partial explanation of the fact under discussion.

Repeated reference has already been made to the much larger percentage of highly digestible carbohydrates in the mature Maine field corn as compared with the immature Southern corn. This

fact must certainly largely account for the superior digestibility of the former. Several examinations of the feces in these experiments have failed to show the presence of sugars or starch, the diastase test being employed for the latter. These carbohydrates being entirely soluble in the digestive fluids, as it was reasonable to expect, their presence in these foods in greatly varying quantities must certainly cause corresponding variations in the digestibility of the nitrogen-free-extract, and consequently of the total dry matter, other things being equal.

That this is so, is easily seen from the figures presented in Table XXII.

TABLE XXII.

DIGESTIBILITY OF NITROGEN-FREE EXTRACT.

	Dry substance fed daily—grams.	In 100 parts dry substance. Per cent starch and sugars.	In 100 parts dry substance. Per cent total nitrogen-free-extract.	Starch and sugars digested daily—grams.	Nitrogen free-extract, other than starch and sugars digested daily—grams.	Per cent starch and sugars digested.	Per cent nitrogen-free-extract digested, other than starch and sugars.	Per cent total nitrogen-free-extract digested.
SILAGE.								
CLXX—Southern Corn silage....	337.5	3.70	46.64	12.5	90.4	100.	62.4	65.4
CLXXI—Field Corn silage	437.7	18.32	59.3	80.2	135.6	100.	75.5	83.1
CLXXIII—Field Corn silage......	408.	17.43	57.9	71.1	114.5	100.	69.3	78.5
CORN FODDER.								
CCXXVII—Field Corn, immature, Sheep 1....................	701.	11.70	46.6	82.	155.6	100.	63.6	72.7
CCXXVII—Field Corn, immature, Sheep 3................. ..	701.	11.70	46.6	82.	150.2	100.	61.4	71.1
CCXXVII—Field Corn, immature, Sheep 4....................	701.	11.70	46.6	82.	147.7	100.	60.4	70.3
CCXXXIII—Field Corn, mature, Sheep 1	689.	31.87	63.3	219.6	92.2	100.	51.	77.9
CCXXXIII—Field Corn, mature, Sheep 3	689.	31.87	63.3	219.6	80.7	100.	44.7	75.5
CCXXXIII—Field Corn, mature, Sheep 4	689.	31.87	63.3	219.6	88.	100.	48.7	76.7

THE DIGESTIBILITY OF THE PENTOSE CARBOHYDRATES.*

W. E. STONE AND W. J. JONES.

†During the past five years attention has frequently been called to the occurrence, in many vegetable materials, of the pentosans, the term being applied to those carbohydrate-like bodies, which, upon hydrolysis produce the pentatomic sugars, arabinose or xylose, as the case may be. The presence of pentosans may be recognized by heating the materials with moderately concentrated hydrochloric or sulphuric acid, when furfurol is formed and may be detected in the vapors by the intense red color produced upon test paper freshly moistened with anilin acetate. This reaction is very sensitive and may be obtained, almost without exception, from all vegetable substances. So far as is at present known furfurol is, under these conditions, produced only from the pentose carbohydrates, with the exception of the rare glucuronic acid and its derivatives. The above mentioned test has therefore come to be regarded as a specific one, and its wide application seems to justify the statement that the pentosans are common constituents of vegetable substances. Upon closer examination it has also been found that many food materials contain the pentosans in very appreciable quantities, and it becomes desirable therefore to know something of their food value and digestibility. The ordinary food analysis, however, quite ignores these bodies except to classify them indiscriminately with all the other soluble non-nitrogenous compounds under the general term "nitrogen-free-extract matter." It is only within a short time, that any analytical method has existed which permits a separate estimation of these bodies. Such methods are now known in two or three modifications, any of which are capable of showing conclusively and with considerable accuracy, the presence of the pentosans under all conditions. It has therefore become possible to

*This article is extracted from Agricultural Science Vol. VII. No. 1. p. 6.

†These extracts are reprinted in this connection partly because of the importance of the results and partly to give added prominence and emphasis to investigation of this sort. Our knowledge of the constitution and properties of many food compounds is sadly deficient, and the most pressing need of to-day in the line of animal nutrition is work of the kind which Dr. Stone and his associates have done in studying the carbohydrate group. Investigations of this class will be potent in shaping future knowledge and will be quoted long after many of the so called practical experiments are buried in a heap of rubbish. W. H. J.

obtain some idea as to the digestibility of these bodies by including these methods among the analytical processes controlling an ordinary digestion experiment.

One of us has already published the results of a brief digestion experiment with rabbits, from which it appeared that in a normal ration about sixty per cent. of the pentosans were digested[1] It was also noticed that the proportion of pentosans to the entire amount of nitrogen-free-extract was much increased in the fæces as compared with the food. These results, however, being based upon meagre data, had little more than a suggestive value, as showing the importance of further study in the same direction. The present paper adds a considerable amount of proof to the previous one without materially changing the conclusions then drawn.

Some months since, Professor W. H. Jordan, Director of the Maine Experiment Station, placed at our disposal a large number of control samples of the food and fæces from digestion experiments, carried on by him during a series of years. These samples had been carefully preserved in air-tight vessels and reached us in excellent condition. We have determined the pentosans in these samples and from the feeding data furnished us by Professor Jordan, we are enabled to report upon their digestibility in twenty different experiments. . . . . The errors . . . . . of the analytical methods and of the assumption upon which the calculations are based, are all such as to minimize the actual results. In the same direction, we have presented here the lowest results obtained from duplicate determinations in each case. The data, here given indicate, therefore, the minimum amounts of pentosans found, so that the results of future study and perfected methods will, we believe, emphasize rather than diminish the conclusions here drawn.

The materials used in the digestion experiments were in part, selected samples of single species of grasses grown for the purpose at the Maine Experiment Station, and the samples were typical of our forage grasses. It is of preliminary interest, therefore, to mark the extent to which the pentosans occur in these and other materials of common and frequent use as cattle foods.

The furfurol (i. e. pentosans) was determined in each sample in duplicate by separate distillations. The lowest of these results was then multiplied by the factor 1.38 to convert it into a value representing pentosans. For comparison, the percentages of nitrogen-free-extract matter as given in Professor Jordan's report, are repeated here. All numbers relate to the dry matter.

	Per ct. furfural. a.	Per ct. furfural. b.	Per cent pentosans (a×1.38).	Per cent N free-extract.
LXXXVI Phleum pratense, in early bloom.........	11.34	11.45	15.65	51.94
LXXXVII Phleum pratense, 10 days after bloom ..	11.72	11.83	16.17	55.51
CXIX Phleum pratense, early cut	9.79	9.85	12.59	46.50
CXX Phleum pratense, late cut......................	10.34	10.91	14.26	51.11
CXL Timothy hay; chiefly Phleum pratense	8.33	8.48	11.50	50.17
CLXI Same; another selection	8.88	8.94	12.25	50.16
LXXXVIII Danthonia Spicata	8.87	9.63	12.24	52.07
LXXXIX Argrostis Vulgaris	9.62	9.62	13.27	53.43
XCVI Calamagrostis Canadensis, in bloom.........	7.83	8.06	10.81	45.25
XCVII Triticum repens...	8.39	8.72	11.58	52.94
CXXVIII Hay of Hungarian grass	9.93	10.23	13.70	47.52
XC Trifolium hybridum	6.41	7.90	8.85	44.39
CXXV Field Corn fodder	11.93	12.05	16.46	52.45
LXXXIII Southern Corn fodder...	8.35	8.57	11.52	46.09
CXXXIII Sugar beets	7.48	8.16	10.32	77.31
CXXX Rutabagas............	5.99	6.11	8.26	71.29
CXXXIV Gluten meal....	4.46	4.70	6.15	52.60
XCII Fancy middlings...............................	6.79	7.02	9.37	64.18
XCI Wheat bran..........................	8.68	9.15	11.88	60.28
CXXXV Wheat bran, another selection	11.56	11.63	15.95	58.93

These results are quite confirmatory of those previously given, showing the presence of appreciable amounts of these bodies in all of these common food materials. The grasses make the largest showing, but in the majority of samples the pentosans amounted to from twenty to thirty per cent of the non-nitrogenous extractive matter.

Accompany the above samples were corresponding samples of the fæces of the animals employed in the digestion experiments, duplicated in each case. We have determined the amount of pentosans in each of these and from the gross weights of the food consumed and fæces excreted have calculated in the usual way the digestibility of the pentosans in question. These digestion experiments were conducted under the usual precautions and control, all of which, together with the analytical data, have been published

in Professor Jordan's reports. The animals experimented upon were sheep in each case. . . . . . Summarizing the results of the preceding experiments, we have the following oversight of the twenty materials studied:

	Per cent of pentosans digested.
LXXXVI Phleum pratense, early bloom	60.4
LXXXVII Phleum pratense, late cut	62.8
CXIX Phleum pratense, early bloom	54 6
CXX Phleum pratense, late cut	48.2
CXL Timothy hay (chiefly Phleum pratense)	48.0
CXLI Timothy hay (chiefly Phleum pratense	49.5
LXXXVIII Danthonia spicata	68.6
LXXXIX Agrostis vulgaris	70.0
XCVI Calamagrostis Canadensis	90.4
XCVII Triticum repens	59.9
CXXVIII Hungarian grass	68.2
XC Trifolium hybridum	56.8
CXXV Fodder of field corn	76.6
LXXXIII Fodder of Southern field corn	69.6
Timothy hay, CXL, and sugar beets	71.3
Timothy hay, CXL, rutabagas	57.1
Timothy hay, CXLI. and wheat bran	45 6
Timothy hay, CXLI, gluten meal	59.1
Hay of Agrostis vulgaris, LXXXIX, and wheat bran,	54 1
Hay of Agrostis vulgaris, LXXXIX, wheat middlings,	64.9

The average of these various results, excluding the data for Calamagrostis Canadensis, which evidently present something anomalous, shows 58.2 per cent of pentosans to have been digested and 41.8 per cent undigested.

These results are worthy of consideration. Twenty of the best known food stuffs for cattle are here shown to contain a minimum of from 6-16 per cent of their dry weight in pentosans, of which an average of only 58.2 per cent is found to be digestible. It appears then, that while these bodies are to be for the present classified among the carbohydrates, they are really much less digestible, and hence of less food value, than the better known members of this group, such as starch, sugar, etc. In many cases the indicated digestibility is even less than that assigned to the fibre of the same

materials and the average of all the experiments is but little higher than the corresponding average for the fibre. Indeed from the data at hand it would appear that of all the food constituents capable of individual estimation, these are among the less soluble in the digestive fluids, although commonly included among those substances which are regarded as in a high degree digestible.

Not only do the pentosans seem to be of low digestibility, but according to Ebstein, the pentoses derived from them by hydrolysis (arabinose and xylose) are little, if at all assimilated, although readily soluble. He has lately shown that the pentose sugars even in very small quantities are not assimilated by the human organism. Xylose taken in doses of less than one dram by healthy persons, could be recognized in the urine after two or three hours, and hence the use of these sugars even by healthy and much more by diabetic persons could yield no beneficial results. In this connection it is of interest to remember that the pentoses are also non-fermentable. As regards their physiological behavior, they are evidently quite distinct from the hexoses, although otherwise resembling them in chemical characteristics. It is not surprising, therefore, that the less soluble mother substance the pentosans, should also prove less digestible than other carbohydrates. In the light of Ebstein's observations, there is, moreover, good reason for believing that even such portions of the pentosans as are dissolved in the digestive tract are, after all, not assimilated.

Chemical Laboratory, Purdue University, November, 1892.

SUMMARY.

(1) A study of the digestibility of the whole corn plant shows it to have a high percentage digestibility as compared with hays and other coarse fodders, especially when allowed to develop to maturity. Of ten samples of Timothy hay, 57 per cent of the dry matter has proved to be digestible, while of Flint corn fodder (whole plant, mature) 71 per cent was digested.

(2) The mature Flint corn has proved to be more digestible than the immature Dent corn, the relation for all trials of fodder and silage being as 72 : 65.

(3) This large difference of digestibility of the two varieties of corn as harvested in Maine is undoubtedly due to the greater proportion of fiber in the Dent corn and to the larger relative amount of entirely digestible sugars and starch in mature Flint corn. This

is shown in part by the fact the excess of digestibility of the latter variety falls largely upon the nitrogen-free extract.

(4) Dr. Stone's investigations of samples of foods and fæces from digestion experiments conducted at this Station show that the pentosans (vegetable gums) were present in all the foods studied, and were digested from 45 per cent to 76 per cent. Dr. Stone observes that there is good reason for believing that even such portions of the pentosans as are dissolved in the digestive tract are, after all, not assimilated.

DATA PERTAINING TO DIGESTION EXPERIMENTS.

TABLE XXII *a*.

COMPOSITION OF THE FECES.

	In 100 parts of dry matter.				
	Ash.	Protein, Nx6.25.	Fiber.	Nitrogen-free-extract.	Fat.
CXLVII—Southern Corn fodder, Sheep 1	10.56	11.32	27.84	48.04	2.24
Sheep 3	11.45	13.46	25.45	47.30	2.35
CXLVI—Field Corn fodder, Sheep 1	11.38	14.69	23.43	47.34	3.14
Sheep 3	11.16	15.89	22.01	48.41	2.53
CXLVIII—Sweet Corn fodder, Sheep 2	11.98	14.06	23.70	47.34	2.92
Sheep 4	11.54	14.27	23.02	48.55	2.62
CLXX—Southern Corn silage, Sheep 1, 2, 3, 4	11.93	12.35	27.84	45.37	2.51
CLXXI—Field Corn silage, Sheep 1, 2, 3, 4	15.33	14.67	21.30	45.53	3.17
CLXXIII—Field Corn silage, Sheep 1, 3	12.48	11.34	21.40	51.62	3.16
CLXXIV—Barley Hay, Sheep 1, 2, 3, 4	10.25	11.72	29.68	43.90	4.45
CCXXXIII—Field Corn fodder, Sheep 1	18.55	12.80	21.77	44.60	2.28
Sheep 3	19.43	12.92	20.56	44.46	2.63
Sheep 4	18.62	14.15	19.84	44.88	2.51
CCXXVII—Field Corn fodder, Sheep 1	13.15	14.32	24.91	44.91	2.71
Sheep 3	15.45	14.87	23.82	42.78	3.08
Sheep 4	13.57	14.65	24.21	44.83	2.74

CALCULATIONS OF DIGESTION CO-EFFICIENTS.

TABLE XXIII.

DIGESTIBILITY OF SOUTHERN CORN FODDER.

SHEEP 1.	Dry substance.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fats.
Southern Corn fodder, CXLVII.							
1,500 grams air-dry fodder daily.....	739.5	685.1	54.05	90.57	237.0	342.6	15.2
Not eaten..............................	139.5	131.4	8.3	10.80	61.8	56.7	2.0
Amount eaten daily	600.0	553.7	45.7	79.77	175.2	285.9	13.2
Excreted in fæces daily.............	231.8	207.2	24.5	26.2	64.5	111.3	5.2
	368.2	346.5	21.2	53.57	110.7	174.6	8.0
Digested, per cent	61.2	62.6	46.2	67.2	63.2	61.1	60.6
SHEEP 3.							
1,500 grams air-dry fodder fed daily.	739.5	685.1	54.0	90.6	237.0	342.6	15.2
Not eaten	65.9	61.6	4.3	4.8	28.6	27.4	.8
Amount eaten daily	673.6	623.5	49.7	85.8	208.4	315.2	14.4
Excreted in fæces daily..............	259.8	230.0	29.7	34.6	66.2	122.9	6.1
Digested..........................	413.8	393.5	20.0	51.2	142.2	192.3	8.3
Digested, per cent..	61.4	63.1	40.2	59.7	68.2	61.0	57.7
Average	61.3	62.8	43.1	63.4	65.7	61.0	59.0

TABLE XXIV.

DIGESTIBILITY OF FIELD CORN FODDER.

SHEEP 1.	Dry substance.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extractive matter.	Fat.
Field Corn Fodder, CXLVI.							
1,500 grams air-dry fodder daily	1,003.5	940.4	62.6	122.6	306.6	491.0	20.3
Not eaten	153.3	143.8	9.7	12.5	60.5	68.3	2.3
Amount eaten daily	850.2	796.6	52.9	110.1	246.1	422.7	18.0
Excreted in feces daily	232.8	206.2	26.5	34.2	54.6	110.2	7.3
Digested	617.4	590.4	26.4	75.9	191.5	312.5	10.7
Digested, per cent	72.6	74.1	50.0	68.9	77.8	73.9	59.4
SHEEP 3.							
1,500 grams air-dry fodder fed daily.	1,003.5	940.4	62.6	122.6	306.6	491.0	20.3
Not eaten...........	160.1	149.5	10.5	14.8	61.1	71.3	2.4
Amount eaten daily	843.4	790.9	52.1	107.8	245.5	419.7	17.9
Excreted in feces daily...............	228.2	202.8	25.3	36.2	50.3	110.5	5.8
Digested.	615.2	588.1	26.8	71.6	195.2	309.2	12.1
Digested, per cent	72.9	74.3	51.4	66.4	79.5	73.7	70.0
Average	72.7	74.2	50.7	67.6	78.6	73.8	64.7

TABLE XXV.

DIGESTIBILITY OF SWEET CORN FODDER.

SHEEP 2.	Dry substance.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Sweet Corn Fodder, CXLVIII.							
1,500 grams air-dry fodder daily	907.5	850.2	57.1	126.7	251.7	442.1	29.8
Not eaten	111.1	101.9	9.2	9.6	42.4	48.4	1.6
Amount eaten daily	796.4	748.3	47.9	117.1	209.3	393.7	28.2
Excreted in feces daily	248.0	218.2	29.7	34.9	58.8	107.1	7.2
Digested	548.4	530.1	18.2	82.2	150.5	186.6	21.0
Digested, per cent	68.8	70.8	38.0	70.2	71.9	72.8	74.5
SHEEP 4.							
1,500 grams air-dry fodder daily	907.5	850.2	57.1	126.7	251.7	442.1	29.8
Not eaten	46.3	42.1	4.1	4.6	18.2	18.9	.6
Amount eaten daily	861.2	808.1	53.0	122.1	233.5	423.2	29.2
Excreted in feces daily	231.8	205.0	26.8	33.1	53.3	112.5	6.0
Digested	629.4	603.1	26.2	89.0	180.2	310.7	23.2
Digested, per cent	73.1	74.6	50.0	72.8	77.3	73.4	79.6
Average	70.9	72.7	44.0	71.5	74.6	73.1	77.0

TABLE XXVI.

DIGESTIBILITY OF SOUTHERN CORN SILAGE.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Southern Corn Silage, CLXX.							
2,500 grams silage daily...	337.5	309.7	27.7	42.2	100.7	157.4	9.4
Excreted daily	120.3	105.9	14.3	14.8	33.5	54.5	3.0
Amount digested	217.2	203.8	13.4	274.0	67.2	102.9	6.4
Per cent digested	64.4	65.8	48.2	64.8	66.7	65.4	67.8

DIGESTIBILITY OF FIELD CORN SILAGE.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Field Corn Silage, CLXXI.							
19,630 grams silage daily	437.7	412.6	25.1	44.2	92.8	259.6	15.9
Excreted daily	96.2	81.4	14.7	14.1	20.5	43.8	3.0
Amount digested	341.5	331.2	10.4	30.1	72.3	215.8	12.9
Per cent digested	78.0	80.2	41.3	68.1	77.9	83.1	80.9

TABLE XXVII.

DIGESTIBILITY OF FIELD CORN SILAGE.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Field Corn Silage, CLXXIII.							
2,000 grams fed daily	408.0	388.7	19.3	41.7	94.4	236.3	16.3
Excreted daily	98.2	85.9	12.3	11.1	21.0	50.7	3.1
Digested	309.8	302.8	7.0	30.6	73.4	185.6	13.2
Per cent, digested	76.0	77.9	36.6	73.3	77.8	78.5	80.9

DIGESTIBILITY OF BARLEY HAY.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Barley Hay, CLXXIV.							
675 grams fed daily	576.2	534.7	41.5	77.1	173.7	267.1	16.6
Not eaten	19.0	17.8	1.2	2.4	5.7	9.2	.4
Consumed daily	557.2	516.9	40.3	74.7	168.0	257.9	16.2
Excreted daily	216.7	194.5	22.2	25.4	64.3	95.1	9.6
Digested	340.5	322.4	18.1	49.3	103.7	162.8	6.6
Per cent, digested	59.1	62.3	44.8	65.2	61.7	63.3	40.5

TABLE XXVIII.

DIGESTIBILITY OF FIELD CORN FODDER (MATURE).

SHEEP 1.	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Field Corn Fodder, CCXXXIII.							
850 grams fed daily	689.0	639.8	49.2	72.7	147.4	400.2	19.6
Excreted daily	198.3	161.5	36.8	25.4	43.2	88.4	4.5
Digested	490.7	478.3	12.4	47.3	104.2	311.8	15.1
Per cent digested	71.2	74.8	25.2	65.1	70.7	77.9	77.0
SHEEP 3.							
850 grams fed daily	689.0	639.8	49.2	72.7	147.4	400.2	19.6
Excreted daily	220.0	177.4	42.8	28.4	45.3	99.9	5.8
Digested	468.8	462.4	6.4	44.3	102.1	300.3	13.8
Per cent digested	68.1	72.3	13.0	60.9	69.3	75.5	70.5
SHEEP 4.							
850 grams fed daily	689.0	639.8	49.2	72.7	147.4	400.2	19.6
Excreted daily	206.5	168.0	38.4	29.2	40.9	92.6	5.2
Digested	482.5	471.8	10.8	43.5	106.5	307.6	14.4
Per cent digested	70.0	73.8	21.9	59.8	72.2	76.9	73.6
Average	69.7	73.6	20.0	68.6	70.7	76.7	73.7

TABLE XXIX.

DIGESTIBILITY OF FIELD CORN FODDER (IMMATURE).

SHEEP 1.	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Field Corn Fodder, CCXXVII.							
850 grams fed daily	701.0	635.6	65.4	104.9	185.8	326.6	18.3
Excreted daily	198.0	172.0	26.0	28.3	49.3	89.0	5.3
Digested	503.0	463.6	39.4	76.6	136.5	237.6	13.0
Per cent digested	71.7	72.9	60.2	72.9	73.4	72.7	70.6
SHEEP 3.							
850 grams fed daily	701.0	635.6	65.4	104.9	185.8	326.6	18.3
Excreted daily	220.6	186.6	34.1	32.8	52.5	94.4	6.8
Digested	480.4	449.0	31.3	72.1	133.3	232.2	11.5
Per cent digested	68.6	70.7	48.1	68.7	71.7	71.1	62.9
SHEEP 4.							
850 grams fed daily	701.0	635.6	65.4	104.9	185.8	326.6	18.3
Excreted daily	216.0	186.8	29.3	31.6	52.3	96.9	5.7
Digested	485.0	448.8	36.1	73.3	133.5	229.7	12.6
Per cent digested	69.2	70.6	55.2	69.8	71.8	70.3	68.4
Average per cent digested	69.8	71.4	54.5	70.4	72.3	71.3	67.3

CORN AS A SILAGE CROP.

W. H. Jordan.

The report of the Station for 1891, pp. 41-46 gives a summary of three years work in testing the relative production of food material by various fodder and root crops. It appeared that the large variety of corn known as Southern White produced the greatest amount of digestible dry substance per acre, excelling root crops, Hungarian grass and other varieties of corn. Since 1891 a comparison between varieties of corn has been continued. This has been done because this crop is an important one to Maine dairymen and because the problems connected with its growth in Maine are local in their nature and cannot be solved by experiments in other states, excepting possibly, New Hampshire and Vermont.

The most common question asked in this connection is, Which are the most profitable varieties to grow, the large, which mature only in a latitude south of New England or the smaller which complete their growth in this climate?

As set forth in the report previously mentioned, the proper test of productiveness is the yield of digestible dry matter, the gross weight of crop or even of total dry matter being deceptive because of differences on the water content and in the digestibility. All effort has been directed, then, towards ascertaining the actual growth of digestible material in the several cases. One other point has necessarily been considered, viz: the relative value of a pound of digestible material in the crops compared. This latter comparison can most safely be made by a feeding experiment and this has been the method used. The study of the corn crop has been conducted in 1892 and 1893 in much the same manner as in previous years only somewhat more comprehensively.

The data recorded in succeeding pages have been obtained,

(1) By weighing the green crop as harvested.

(2) By immediate drying of the green product to ascertain the dry matter.

(3) By analysis of the dry matter to determine its composition.

(4) By a partial chemical study of the nitrogen-free-extract.

(5) Digestion experiments with sheep.

All this work centers around two problems: First, the relative yield of digestible dry matter in immature Southern Dent corn and in mature Maine field corn: and second, the influence of maturity on the amount and kind of product.

Weight of Green Product. This was ascertained by cutting the whole field, and hauling to the barn and weighing as fast as cut.

Determination of Dry Matter. Several hundred pounds carefully selected from the several rows of each plot were cut by the horse power fodder cutter, thoroughly mixed, from which a large sample was taken for drying in a steam closet.

Chemical Analysis. These results have been described in previous pages. The ordinary analysis was by the methods of the A. O. A. C.

Digestion Experiments. These trials have been carried on either with the partially dried fodder or with the silage made from it. The detailed results of these experiments have been previously given.

Manuring and Method of Planting. 1892. Field No. 1. Size one acre, soil, a loam, somewhat lighter than clayey loam, shading towards sandy. Summer fallowed in 1891 to kill witch grass. About six cords of stable manure and a fertilizer consisting of four hundred pounds dissolved bone black, one hundred pounds muriate of potash, and seventy-five pounds nitrate of soda, applied in spring. Planted in rows three and one-half feet apart, with kernels six inches apart in drills. Level, clean culture. Planted May 19th, harvested September 6th to 9th.

Field No. 2. Size, one acre, soil, clayey loam. Planted to corn in 1891. About seven cords of stable manure and the same amount and kind of fertilizer as on Field No. 1, applied in spring. Culture and planting same as Field No. 1. Planted May 19th, harvested September 6th-9th.

1893. Field No. 1, same as in 1892. About six cords of stable manure and five hundred pounds of Bay State fertilizer, applied in spring. Planting and culture as 1892. Planted May 31st, harvested September 14th to 16th.

Field No. 2, same as in 1892. Manuring, planting and culture same as Field No. 1. Planted May 31st, harvested September 14th to 16th.

In both fields, during both years, each acre was divided into twenty plots, the two kinds of corn alternating, ten plots being devoted to each. It is scarcely possible to secure conditions more uniform in which to compare the growth of two crops than existed in these experiments.

The results secured are concisely stated in Table XXX, all intermediate data such as size of plots and yield per plot, being omitted.

The figures for the three years previous are stated for the sake of comparison.

TABLE XXX.

COMPARATIVE YIELD OF SOUTHERN CORN AND MAINE FIELD CORN, AS GROWN IN MAINE—YIELD PER ACRE.

	Green corn, (whole plant)—pounds.	Dry substance.		Digestible dry substance.	
		Per cent.	Pounds.	Per cent.	Pounds.
Crop of 1888.					
Southern Corn	26,295	12.30	3,234.3	65	2,102.3
Maine Field Corn	14,212	17.4	2,472.9	70	1,720.5
Crop of 1890.					
Southern Corn	32,950	14.94	4,922.7	69	3,396.7
Maine Field Corn	15,300	15.84	2,415.9	71	1,715.3
Crop of 1891.					
Southern Corn	46,340	13.46	6,237.4	61	3,804.8
Maine Field Corn	28,080	13.55	3,804.8	73	2,777.5
Crop of 1892.					
Southern Corn, Field 1	37,320	14.67	5,474.8	64	3,503.9
Field 2	34,820	14.15	4,927.0	64	3,153.2
Maine Field Corn, Field 1	22,490	20.90	4,700.0	78	3,666.0
Field 2	29,400	18.64	5,480.0	76	4,164.8
Crop of 1893.					
Southern Corn, Field 1	39,066	15.45	6,036.7	* 65	3,923.2
Field 2	26,660	16.58	4,420.2	* 65	2,873.1
Maine Field Corn, Field 1	27,780	25.43	7,064.4	70	4,945.0
Field 2	18,610	19.50	3,628.9	70	2,540.2
Southern Corn, 7 trials.					
Maximum	46,340	16.58	6,237.4	69	3,923.2
Minimum	26,295	12.30	3,234.3	61	2,102.3
Average	34,761	14.50	5,036.0	65	3,251.0
Maine Field Corn, 7 trials.					
Maximum	29,400	25.43	7,064.4	78	4,945.0
Minimum	14,212	13.55	2,415.2	70	1,715.3
Average	22,269	18.75	4,224.0	73	3,076.0

* The average of previous years.

The foregoing figures show a large variation in production in different years, under conditions other than the season, quite uniform. This variation is not alone in gross weight of crop, but in dry matter as well The largest quantity of dry matter produced in any case during five years is nearly three times that yielded by the smallest crop. This is due in part to the manuring and cultivation and in part to the character of the season.

Had these experiments been discontinued after 1891 the outcome would have been decidedly favorable to the large variety of Dent corn, but in 1892 and 1893, the relation of yield has been reversed and the smaller variety of Flint corn has taken the lead. It is probable that another five years' series of comparisons would furnish a somewhat similar experience.

The general outcome for the five years is slightly favorable to the large variety of corn if we consider only the yield of digestible dry matter. But when we take account of the fact that in the one case an average of five and one-half tons more of material have annually been handled over several times, we are led to conclude that the smaller, less watery variety of corn has really proved the more profitable.

It is significant, also, that the largest yield of dry matter in any instance has been from the smaller variety. While the Flint corn grown in this State is not capable of producing so much dry substance as the large variety of Dent corn, under circumstances equally favorable for both, the former cannot in this latitude reach anything like maturity, and so loses the advantage of that period when growth is most rapid, as subsequent figures show.

The writer has made one or two observations during these five years which may be worth noting. One is that the cut worm scarcely ever molests the large Dent corn, even when feeding freely on the smaller Flint variety. This fact was observed during two years. It is also the writer's opinion, from observation, that conditions unfavorable as to fertility and cultivation will reduce the growth of the Maine corn to the greater extent.

A condensed summary of the results which are the outcome of this series of experiments, appears below. These statements stand somewhat in conflict with those of the 1891 report. It must be remembered, however, that the honest experimenter is limited in his conclusions to the facts which appear after a careful analysis of data. Facts should always outweigh existing opinions. Such a

rule of action often requires a reversal of former conclusions. This experience may be unfortunate but is not blameworthy.

(1) The average weight per acre of the green crops for five years were: Southern corn, 34,761 pounds; Maine field corn, 22,269 pounds; difference, 11,492 pounds, or nearly five and three-fourths tons.

(2) The average dry matter per hundred pounds was nearly one-third more in the Maine field corn, the relation being: Southern corn 14.50 pounds; Maine field corn 18.75 pounds, or as 100:129.

(3) The Maine field corn proved to be more digestible, the relation for dry matter being: Southern corn, 65; Maine corn, 73, or as 100:112.

(4) The average pounds of digestible dry matter per hundred pounds of green corn have been: Southern corn 7.25 pounds; Maine field corn 13.69 pounds, or as 100:189.

(5) The average yield of dry matter per acre has been: Southern corn 5,036 pounds,—extremes, 7,064 pounds and 2,415 pounds.

(6) The average yield of *digestible* dry matter has been: Southern corn 3,251 pounds,—extremes 3,923 pounds and 2,102 pounds; Maine field corn 3,076 pounds,—extremes 4,945 pounds and 1,715 pounds.

(7) The yield of digestible dry matter has averaged 175 pounds more per acre with the Southern corn. To offset this it has been necessary to handle annually five and three-fourths tons more weight.

(8) The largest as well as the smallest yield of digestible dry matter in a single year has been furnished by the Maine field corn.

THE INFLUENCE OF MATURITY UPON THE VALUE OF THE CORN CROP FOR FODDER OR SILAGE PURPOSES.

There have existed, without doubt, some very erroneous notions in regard to the relative value of the corn crop at different stages of growth. Corn that is thickly planted and cut when quite immature is so easily masticated and is eaten with such evident relish, that such material has by many been regarded more highly than the facts warrant. Correct views prevail to a greater extent than formerly, partly because several careful experiments, the results of which have been widely published, show that the plant continues to increase its store of dry substance until full maturity and that this growth is very rapid during the last stages of development.

It was understood, therefore, that an experiment along this line would be to an extent a repetition. Nevertheless for several reasons it was thought best to do this. In the first place an unusually good opportunity was offered to secure uniform conditions as to soil. Again, the outcome whatever it might be would be a more valuable object lesson to Maine farmers than results reached in some other state. Finally, it was desired to learn something as to the nature of the growth which is so rapid at approaching maturity.

The field of corn selected for studying the influence of maturity was the one designated as Field No. 1 (1893). The corn was of very uniform growth, being finely eared and in every way satisfactory for experimental purposes.

Each of the ten plots consisted of five rows, and it was decided to harvest one-fifth of the crop or one-tenth of an acre at each of five periods of growth, cutting one row of each plot at each period. As in other similar experiments, quite an amount of each lot was finely chopped, and a portion of this was immediately dried in a steam closet.

TABLE XXXI.

PRODUCTION OF THE CORN PLANT AT DIFFERENT STAGES OF GROWTH.

Date of cutting and condition of crop.	Days in each period of growth.	Yield of green corn per acre.	Dry substance.		Gain in weight in e'ch period, dry matter—lbs.	Rate of gain per day—dry matter—lbs.
			Per cent. in crop.	Total yield per acre—lbs.		
August 15th, ears beginning to form		26,166	11.71	3,064.0		
August 28th, a few roasting ears	13	29,777	17.50	5,210.9	2,146.9	165.0
Sept. 4th, all roasting ears...........	7	31,000	19.55	6,060.5	849.6	121.3
Sept. 12th, some ears glazing.......	8	28,833	23.17	6,680.6	620.1	77.5
Sept. 21st, All ears glazed............	9	27,777	25.34	7,039.7	358.1	39.8
Total increase after August 15th	–	–	–	–	3,974.7	

The results of this experiment certainly furnish a striking illustration of the folly of harvesting immature corn for silage purposes whenever it is possible to allow it to attain maturity.

In this instance, the quantity of dry matter in the corn at maturity was nearly two and one-half times greater than at the silking period thirty-seven days previous, the average rate of increase per acre of dry substance being about 108 pounds daily. This daily increase is equivalent in quantity to one day's ration for four or five cows of ordinary weight.

The character of this growth has been clearly set forth on previous pages, in discussing the analyses of these samples of corn fodder. The facts that appear can be emphasized, however, by a display of the quantities of the different classes of nutrients found to exist at the different periods of growth.

The figures in Table XXXII are the results of applying the foregoing analyses to the total yield of dry matter

TABLE XXXII.

PRODUCTION OF DIFFERENT CLASSES OF COMPOUNDS BY THE CORN PLANT AT DIFFERENT STAGES OF GROWTH.

	Ash.	Protein, N×6.25.	Fiber.	Nitrogen-free-extract.	Sugars.	Starch.	Fat.
August 15th, ears beginning to form*	285.9	458.4	812.3	1,428	358.5	–	79.7
August 28th, a few roasting ears	338.7	611.7	1,214.0	2,892	1,064.0	108	153.7
September 4th, all roasting stage....	376.3	689.6	1,192.0	3,621	1,248.0	297	181.8
September 12th, some ears glazing..	372.4	639.5	1,291.0	4,177	1,407.0	357	200.4
September 21st, all ears glazed......	416.1	649.8	1,309.0	4,457	1,161.0	1,083	208.4
Gain after August 15th..............	130.2	191.4	496.7	3,029	802.5	1,083	128.7
Gain after August 28th	77.4	38.1	95.0	1,565	97.0	975	54.7

*The manner of drying the sample taken from the lot cut at this period may have caused a loss of sugar.

From August 15th to August 28th there appears to have been considerable growth of the compounds of all classes, but after that date the increase of dry matter was due chiefly to the formation of one class of compounds. After August 28th, and until September 21st, the total growth was 1,828 pounds of dry matter, 1,565 pounds of which, or all but 263 pounds, belonged to the nitrogen-free-extract. Of this 1,565 pounds, 1,072 pounds consisted of sugars and starch. Two facts are clearly shown: First, that the later growth of dry matter in the corn plant is made up chiefly of non-nitrogenous compounds; and second, a large percentage of these compounds consisted of sugars and starch, substances that are the best of their class for the purposes of animal nutrition.

Feeding Experiments.

W H. Jordan.

There are two methods of judging the value of cattle foods. In common parlance one would be styled "scientific" and the other "practical." Both may be correctly classed as scientific or as practical according to the manner in which they are carried out and the standpoint from which they are regarded. Certainly if a conclusion is reached through truly scientific means it must have an entirely practical application, and no conclusion can be safely applied to the management of a business, which has not been reached in a way that is essentially scientific.

The two methods by which we may study a cattle food in trying to estimate its value, are: First, determine its composition and digestibility and then from known principles and the facts determined derive an opinion as to the place this food will take in stock feeding; and second, to feed this food to a given class of animals, under conditions as definite and as well controlled as possible, note the apparent results, and base a conclusion upon these. The conclusions should be the same by both methods provided that on the one hand it is possible to find out not only the amounts but the nutritive office of all the compounds which the food contains, and that on the other hand, perfect control and knowledge of every factor involved in a feeding experiment can be secured. In neither case are we now able to realize a satisfactory standard of work, and so in comparing the two methods it is only a question of which one can be so carried out as to be entitled to the greater degree of confidence.

Of course the ultimate appeal must in a general way always be to the animal, and the strongest conclusions are those supported both by theoretical considerations and actual results.

A question may arise, however, where from the standpoint of the chemist a clear answer is given, which answer is not ratified by the results of a feeding experiment, as to which is at present the more reliable basis of judgment, the knowledge gained by a chemical study of the food, or the apparent outcome of an actual feeding trial. For instance, it is desired to compare the feeding value of

bran and fine middlings. The composition of the two is found not to differ greatly so far as it is a question of the relative amounts of the several classes of compounds, and the digestibility of the former is found to be much less than that of the latter. These facts regarded in the light of approved theories, warrant the conclusion that the feeding value of the middlings is the greater. But a feeding trial in which rations, containing in some periods bran and in others, middlings, are compared, either does not show the expected difference, or declares one altogether larger than other facts seem to warrant. Are we, then, to conclude the theory is wrong? Certainly not from a single trial. So many conditions, such as the lengthening of the period of lactation, the temperature of the barn, variations in weight due to a change in intestinal contents, and the unreckoned or unmeasured increase or decrease of the flesh of the animal (if with cows), enter into a feeding trial as unknown factors, that such differences as exist between two grain foods may either be covered up or greatly exaggerated. Nothing short of several feeding trials should be allowed to throw a doubt upon the correctness of theories that appear to be well substantiated by severe methods of investigation, and even then the points of disagreement would, doubtless, be regarded as unsettled questions.

Fortunately, however, the value to farm practice of the feeding trials here reported is not lessened by apparent discrepancies between the outcome which general principles would seem to dictate and the results actually reached. The experiments which are discussed in this connection are the following:

(1) The relative feeding value of Southern corn silage and Maine field corn silage.

(2) The influence of widely differing rations upon the quantity and composition of milk.

(3) Experiments with swine.

(*a*) Relative economy of production with different breeds.

(*b*) The market value of different breeds.

(*c*) The comparative value of nutrients from skimmed milk and from vegetable foods.

(*d*) The economy of production at different ages.

FEEDING EXPERIMENTS WITH COWS.

THE RELATIVE FEEDING VALUE OF SOUTHERN CORN SILAGE AND MAINE FIELD CORN SILAGE.

The discussion on previous pages of the comparative composition and digestibility of Southern corn and Maine field corn, makes plain three facts:

1st. The Maine Corn contains less water or more dry matter than the other.

2nd. The dry matter of the Maine Field Corn is the more digestible of the two kinds.

3rd. This difference is due to the formation in the Maine Field Corn, while maturing, of compounds that are wholly digestible and of the highest nutritive value.

These facts as plainly declare as facts can that the one variety of corn is worth much more than the other in feeding value, if equal weights are compared. Can this be shown in practice? Will the animal ratify the conclusion that the digestible dry matter, when judging foods of the same class, is a safe standard of comparison? What is the influence of maturity on the value of the digestible dry matter as shown by experience?

These questions as related to silage corn were submitted to the test of a feeding experiment for milk production in the winter of 1892-3. The plan of the experiment was a simple one. It was divided into three periods, of about one month each, the only essential changes in the rations of the several periods being a substitution of one kind of silage for the other. It was intended to supply the same quantity of digestible material from each of the two kinds of silage. This was not done, however, because it was not possible to ascertain the actual composition and digestibility of these materials until during the time they were being fed, and more digestible dry substance was consumed in the Maine Field Corn Silage than in the other. The data noted in this experiment include:

(1) The weights of food consumed.

(2) The composition and digestibility of the foods.

(3) The weights of water drank.

(4) Variation of the live weights of the cows. (The cows were weighed on three successive days of each week.)

(5) The yield of milk. (Each mess of milk was weighed.)

(6) The composition of the milk. (Each mess of milk was analyzed for five successive days during the last week of each period.)

From the facts supplied by such a collection of data it was hoped to derive evidence of a somewhat decisive character, so far as this can be accomplished by a single experiment. These data are displayed in the several tables of figures which follow.

RATIONS.

Period 1.	Nov. 21st to Dec. 18th,	14 pounds Barley Hay. 40 pounds Southern Corn silage (No.CLXX). 6 pounds grain mixture.
Period 2.	Dec. 19th to Jan. 18th,	14 pounds Barley Hay. 30 pounds Maine Field Corn silage (No. CLXXI). *6 pounds grain mixture.
Period 3.	Jan. 19th to Feb. 16th,	12 pounds Timothy Hay. 40 pounds Southern Corn silage (No. CLXXVI). *6 pounds grain mixture.

* The cow Nancy Avondale was fed 7 pounds grain mixture.

TABLE XXXIII.

COMPOSITION OF FOODS.

	Dry matter.	Digestible material.			
		Organic matter.	Protein.	Carbo-hydrates.	Fat.
	%	%	%	%	%
Southern Corn silage, CLXX*.. ...	13.5	8.3	1.10	6.8	.25
Southern Corn silage, CLXXVI*.. .	16.2	10.0	1.70	7.8	.50
Field Corn silage, CLXXI	22.3	16.8	1.50	14.7	.65
Barley Hay*.........................	85.37	50.3	7.4	40.6	1.00
Timothy Hay.........................	87.50	48.2	3.33	42.9	1.76
Corn meal	89.4	77.3	8.0	65.4	4.25
Bran..................................	88.5	51.8	13.2	34.8	2.9
Gluten meal	90.4	78.9	22.9	48.7	5.35
Cotton seed meal	91.8	68.5	36.8	17.9	12.3

* The composition and digestibility of these foods were actually determined. For the other foods average figures were used.

TABLE XXXIV.

NUTRANTS IN DAILY RATIONS,—(POUNDS).

	Dry matter.	Total organic matter.	Protein.	Carbo-hydrates.	Fats.
*First period	22.7	14.23	2.47	11.15	.61
*Second period................................	24.0	16.00	2.47	12.84	.71
*Third period.	22.4	14.00	2.07	11.02	.91
Nancy Avondale { Second period.....	24.9	16.7	2.63	13.3	.77
Nancy Avondale { Third period..................	23.2	14.5	2.23	11.4	.84

* The same for all cows except Nancy Avondale.

TABLE XXXV.

WATER DRANK DAILY.

	Agnes—pounds.	Dins.—pounds.	L. T.—pounds.	Shaw—pounds.	N. A.—pounds.
First period	52.4	56.8	48.1	53.0	
Second period	51.4	56.5	48.0	51.9	65.6
Third period	45.9	48.9	45.7	40.8	57.4

TABLE XXXVI.

WEIGHTS OF THE COWS.

FIRST PERIOD.	Agnes.	Dins.	L. T.	Shaw.	N. A.
First week	*870	867	836	965	
Second week	870	853	831	958	
Third week	863	843	834	955	
Fourth week	861	850	840	945	
Average	866	853	835	956	
SECOND PERIOD.					
First week	845	847	821	938	990
Second week	837	832	816	929	990
Third week	834	830	823	946	987
Fourth week	833	832	820	946	986
Average	837	835	820	940	988
THIRD PERIOD.					
First week	843	843	830	963	965
Second week	852	845	835	976	958
Third week	838	841	837	959	955
Fourth week	840	845	833	952	945
Average	843	843	834	962	956

* Each number represents the average of three weighings.

TABLE XXXVII.

MILK YIELD,—POUNDS PER WEEK.

	N. A.	Agnes.	Dins.	L. T.	Shaw.
November 27th to December 18th, inclusive, 22 days.					
First week		185.4	181.4	175.9	141.3
Second week		176.3	177.5	170.1	138.6
Third week		174.3	174.7	166.1	142.1
Last day		26.5	24.6	25.3	20.0
Total yield		562.4	558.3	537.4	442.0
Average daily yield		25.6	25.3	24.4	20.1
December 25th to January 18th, inclusive, 25 days.					
First week	246.3	172.6	169.5	173.0	139.1
Second week	239.9	176.5	177.4	175.8	143.9
Third week	236.7	172.3	175.6	164.7	137.1
Last four days	138.9	98.0	99.1	98.6	73.9
Total yield	861.7	619.4	621.6	612.2	494.0
Average daily yield	34.5	24.8	24.9	24.5	19.8
January 22d to February 16th, inclusive, 26 days.					
First week	224.0	159.0	167.7	172.7	131.0
Second week	225.0	158.5	162.0	167.4	127.6
Third week	214.1	153.4	157.6	164.5	127.5
Last five days	151.3	106.4	108.9	112.5	88.7
Total yield	814.4	577.4	596.3	617.1	474.9
Average daily yield	31.3	22.2	22.9	23.7	18.3

TABLE XXXVIII.

AVERAGE DAILY YIELD OF MILK.

	Agnes. Pounds.	Dins. Pounds.	L. T. Pounds.	Shaw. Pounds.	N. A. Pounds.
First period, Nov. 27th to Dec. 18th—22 days	25.6	25.3	24.4	20.1	
Second period, Dec. 25th to Jan. 18th—25 days	24.8	24.9	24.5	19.8	34.5
Third period, Jan. 22d to Feb. 16th—26 days	22.2	22.9	23.7	18.3	31.3

TABLE XXXIX.

AVERAGE COMPOSITION OF FIVE DAYS' MILK IN EACH PERIOD.

	Agnes.		Dins.		L. T.		Shaw.		N. A.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
	%	%	%	%	%	%	%	%	%	%
First period	13.44	4.4	14.02	4.5	12.99	3.9	14.22	4.8		
Second period	14.09	4.8	14.56	4.9	13.84	4.4	15.16	5.4	12.05	3.2
Third period	14.02	4.9	14.68	5.1	13.46	4.4	14.72	5.3	11.66	3.0

TABLE XL.

DAILY YIELD OF MILK SOLIDS,—POUNDS.

	Agnes.	Dins.	L. T.	Shaw.	N. A.	Average.
First period	3.43	3.55	3.17	2.85	–	3.24
Second period	3.49	3.62	3.39	3.00	4 15	*3.37
Third period	3.11	3.37	3.19	2.69	3.65	*3.09

* N. A. not included in these averages.

TABLE XLI.

POUNDS DIGESTIBLE FOOD EATEN FOR EACH POUND MILK SOLIDS PRODUCED.

	Agnes.	Dins.	L. T.	Shaw.	N. A.	Average.
First period	4.16	4.00	4.49	4.99	–	4.41
Second period	4.58	4.42	4.72	5.33	4.02	*4.79
Third period	4.50	4.15	4.39	5.20	4.00	*4.56

* Averages, excluding N. A.

It appears that in the first two feeding periods fourteen pounds of barley hay and mixed grain were fed besides the silage, and that in the third period twelve pounds of Timothy hay took the place of the barley hay. Forty pounds of Southern corn silage were fed in the first and last periods and thirty pounds of Field corn silage in the middle or second period. The daily digestible food for each of the three periods was 14.23 pounds, 16 pounds and 14 pounds respectively, so that the substitution of thirty pounds of Maine field corn silage for forty pounds of Southern corn silage had the effect of increasing the daily composition of digestible material by nearly two pounds. The fact that the daily ration of digestible material did not remain practically the same in all periods, introduces an element of uncertainty into the conclusions which may be drawn.

The relative effect of these rations must be seen, if at all. by studying their effect upon the bodily condition of the animals and upon the production of milk. If we do this we find that the cows lost from fifteen to thirty pounds weight in passing from the first to the second periods and that this loss was partially regained during the third period. These changes in live weight can be readily explained by the less weight of silage eaten in the second period, with no marked change in the quantity of water drank in any period.

Ordinarily in an experiment of this kind, extending through three months or more, there is a gradual but continuous decrease in the volume of the milk yield, unless there is a change in the food favorable to an increased milk production. When we see that in the second period of this experiment practically the same weight of milk was produced, and that owing to an increase in the dry matter of the milk there was actually a larger production of milk solids, we have good presumptive evidence that the ration containing the thirty pounds of Field corn silage was more efficient than the previous ration containing forty pounds of Southern corn silage. This evidence is strengthened by the fact that when in the third period a return is made to the Southern corn silage the yield of milk solids is decidedly diminished. Nevertheless, as stated in the preliminary discussion of feeding experiments, minor differences in two rations, such as existed in this experiment are not easily measured where so many uncontrolled and unmeasured factors exist.

The best possible analysis of the evidence that is secured in this case seems, however, to be entirely in favor of the conculsion that pound for pound the Maine Field Corn Silage was worth more than the Southern Corn silage, and that the difference was practically in the proportion of the amount of digestible dry substance in the two materials. This is the result which a careful consideration of the facts learned in other ways would lead us to expect.

THE INFLUENCE OF WIDELY DIFFERING RATIONS UPON THE QUANTITY AND QUALITY OF MILK.

There is no question more generally discussed by dairymen just at this time than the influence of the food of a cow upon the amount and kind of milk. It is agreed on all sides that the quantity of milk is up to a certain limit very largely dependent upon the quantity and kind of food. Many farmers also express themselves as convinced that the quality of milk is materially modified by the kind of food, and so we hear such expressions as "feeding for milk" and "feeding for butter," as though a ration that will cause an increased flow of milk will not necessarily increase the butter production.

The opinion largely held by agricultural chemists and others who regard this question in the light of the results of experiment and investigation, is that the quality of milk is practically controlled by the individuality of the animal and that within the limits of healthful feeding the composition of the milk is not to be greatly influenced by the kind of food. It is conceded that marked changes occur in the milk of the same animal, such as daily variations, and variations due to protracted lactation, changes of season, weather and other causes not well defined. The fat in the milk may differ one per cent on two successive days, without apparent cause, although at other times a reasonable explanation may appear. The fact that when cows are fed each day exactly the same quantity of the same kind of food the milk does not remain constant in composition, but varies to a material extent, furnishes an element of uncertainty in interpreting the results of those feeding experiments which have for their object a study of the influence of food upon milk. It is not always easy to become satisfied that any change in the milk is due to a known cause.

Many experiments have been carried on for the purpose of throwing light upon the problem here presented, and while the testimony

is largely on one side, it is to some extent conflicting. Up to the present date, however, the concensus of opinion is as before stated, that the animal is the determinative factor. There are numerous facts in common experience which accord with this opinion. Every farmer recognizes marked differences in the milk of the several animals in his herd and he is well aware that by no sort of manipulation of food can he obliterate these differences and reduce the milk of all his different animals to a dead level of quality. Whatever practice he may adopt in feeding he will still have "poor-milk" cows and "rich-milk" cows. It is a matter of common observation that certain breeds furnish milk of a characteristic quality and no one has yet discovered a way of converting a Jersey's milk into the kind the larger and more showy Holstein yields, neither do we know how to coerce the latter into supplying us with the richness of color and composition which we have imported from the Channel Islands. It is reasonable to regard lactation as a function, which, both as to the kind and the maximum quantity of the product, is fixed chiefly by the constitutional limitations of the individual.

It has been supposed possible for changes in the food to cause the composition of the resulting milk to vary in two ways, viz: by increasing or decreasing the percentage of solid matter, and by changing the composition of the solids, as for instance, increasing the fat without a corresponding increase of casein.

The experiment with cows, the results of which are given in this connection, was planned with reference to changes in the rations so radical as to induce if possible corresponding variations in the character of the milk. The attempt was not to compare a starvation diet with liberal feeding, because no one believes a starvation ration to be wise or profitable, and liberal feeding is universally regarded as a part of the creed of successful agriculture. But while there is a general agreement that the ration should be generous in quantity and agreeable in quality, there is much discussion as to the way in which this ration should be compounded and the relative effcet of different mixtures of the nutrients, and so the rations in this experiment were made to differ very widely in the relation of the nitrogenous to the non-nitrogenous nutrients.

The experiment was begun with four cows, one of which was dropped out and results are reported from only three. The three feeding periods covered one hundred and five days, or thirty-five days each.

The three cows were designated as A, R, and L. T. The two rations compared were as follows:

RATION 1.

Timothy hay	ad lib.
Corn meal	2 pounds.
Cotton-seed meal	2 pounds.
Gluten meal	2 pounds.

RATION 2.

Timothy hay	ad lib.
Corn meal	6 pounds.

Ration 1 was fed to A during the first and third periods, and to R and L. S. during the second or middle period. Ration 2 was fed to A in the middle period and to R and L. S. in the first and third periods.

A record was made of the food consumed and of the weights of milk produced. During the last five days of each period the milk was analyzed. The butter was also submitted to tests for melting points, the percentages of volatile acids and for the iodine absorption equivalent.

The data are all given in the subsequent tables.

TABLE XLII.

FOOD EATEN.

Period 1.	Period 2.	Period 3.
Cow A.		
804 lbs. Timothy hay. 70 lbs. corn meal. 70 lbs. gluten meal. 70 lbs. cotton-seed meal.	740 lbs. Timothy hay. 210 lbs. corn meal.	750 lbs. Timothy hay. 70 lbs. corn meal. 70 lbs. gluten meal. 70 lbs. cotton-seed meal
Cow R.		
777 lbs. Timothy hay. 210 lbs. corn meal.	770 lbs. Timothy hay. 70 lbs. corn meal. 70 lbs. gluten meal. 70 lbs. cotton-seed meal.	710 lbs. Timothy hay. 210 lbs. corn meal.
Cow L. T.		
777 lbs. Timothy hay. 210 lbs. corn meal.	770 lbs. Timothy hay. 70 lbs. corn meal. 70 lbs. gluten meal. 70 lbs. cotton-seed meal.	680 lbs. Timothy hay. 210 lbs. corn meal.

AVERAGE WEIGHTS OF COWS,—POUNDS.

	Cow A.	Cow R.	Cow L. T.
First period	876	859	866
Second period	872	853	837
Third period	846	840	831

TABLE XLIII.

DAILY RATIONS IN TERMS OF DIGESTIBLE NUTRIENTS,—POUNDS.

PERIOD 1.	Cow 1.	Cow 2.	Agnes.
Dry substance	24.8	24.8	25.5
Organic digestible matter	15.3	15.3	15.6
Digestible protein	1.21	1.21	2.12
Digestible carbohydrates	13.4	13.4	12.5
Digestible fats	.64	.64	.85
Nutritive ratio	1: 12.3	1: 12.3	1: 6.8
PERIOD 2.			
Dry substance	24.7	24.7	23.8
Organic digestible matter	15.1	15.1	14.8
Digestible protein	2.09	2.09	1.18
Digestible carbohydrates	12.07	12.07	12.97
Digestible fat	.84	.84	.63
Nutritive ratio	1: 6.7	1: 6.7	1: 12.3
PERIOD 3.			
Dry substance	23.1	22.3	24.1
Digestible organic matter	14.4	14.	14.8
Digestible protein	1.15	1.13	2.06
Digestible carbohydrates	12.62	12.24	11.82
Digestible fats	.81	.60	.82
Nutritive ratio	1: 12.3	1: 12.00	1: 6.6

TABLE XLIV.

YIELDS OF MILK.

Period 1. (December 12th to January 15th inclusive.)

	Cow A. Nitrogenous ration.—pounds.	Cow R. Corn meal ration.—pounds.	Cow L. T. Corn meal ration.—pounds.
First week	172.0	126.5	128.7
Second week	185.9	114.2	120.8
Third week	182.0	128.5	128.0
Fourth week	183.2	106.6	116.4
Fifth week	190.6	108.7	112.9
Total for last four weeks	741.7	458.1	478.0
Average per day	26.5	16.4	17.4

Period 2. (January 16th to February 19th inclusive.)

	Cow A. Corn meal ration.—pounds.	Cow R. Nitrogenous ration.—pounds.	Cow L. T. Nitrogenous ration.—pounds.
First week	175.4	129.2	117.3
Second week	151.8	149.1	139.7
Third week	146.0	149.8	135.6
Fourth week	133.2	141.6	130.2
Fifth week	129.3	146.1	128.6
Total for last four weeks	560.2	580.6	534.2
Average per day	20.0	20.7	19.1

TABLE XLIV—CONCLUDED.

Period 3. (February 20th to March 25th inclusive.)

	Cow A. Nitrogenous ration.—pounds.	Cow R. Corn meal ration.—pounds.	Cow L. T. Corn meal ration.—pounds.
First week	154.4	124.1	114.0
Second week	176.8	108.1	110.5
Third week	172.5	106.3	100.7
Fourth week	172.4	95.4	98.9
Fifth week	169.3	84.0	87.8
Total for last four weeks	691.0	393.8	397.9
Average per day	24.7	14.1	14.2

SUMMARY.

	Cow A. Pounds.	Cow B. Pounds.	Cow L. T. Pounds.
Average total yield on nitrogenous ration	716.4	580.6	534.2
Average total yield on corn meal ration	560.2	425.9	437.9
Excess of yield with nitrogenous ration	156.2	154.7	96.3
Daily yield with nitrogenous ration	25.6	20.7	19.1
Daily yield with corn meal ration	20.0	15.2	15.6
Daily excess with nitrogenous ration	5.6	5.5	3.5

TABLE XLV.

COMPOSITION OF THE MILK.

		Total solids. %	Casein and albumen. %	Fat. %
Cow A.,	First period, nitrogenous ration.	14.06	3.76	4.70
	Second period, corn meal ration,	13.39	3.45	4.24
	Third period, nitrogenous ration	14.17	3.51	4.74
Cow R.,	First period, corn meal ration....	13.26	3.47	4.07
	Sec'nd period, nitrogenous rat'n,	13.92	3.67	4.77
	Third period, corn meal ration..	14.03	3.38	4.84
Cow L. T.,	First period, corn meal ration...	13.38	3.48	3.99
	Sec'nd period, nitrogenous rat'n,	14.27	3.67	4.72
	Third period, corn meal ration..	13.62	3.12	4.55

TABLE XLVI.

YIELD OF MILK SOLIDS.

		In 28 days.	In one day.
Cow A.,	First period, nitrogenous ration	104.3 pounds	3.72 pounds
	Second period, corn meal ration	75.0 pounds	2.68 pounds
	Third period, nitrogenous ration	97.9 pounds	3.50 pounds
Cow R.,	First period, corn meal ration...........	60.7 pounds	2.17 pounds
	Second period, nitrogenous ration	80.8 pounds	2.88 pounds
	Third period, corn meal ration	55.3 pounds	1.97 pounds
Cow L. T.,	First period, corn meal ration...........	63.9 pounds	2.28 pounds
	Second period, nitrogenous ration.......	76.2 pounds	2.72 pounds
	Third period, corn meal	54.2 pounds	1.93 pounds

SUMMARY.

	Cow A.	Cow R.	Cow L. T.
	Pounds.	Pounds.	Pounds.
Av. daily yield milk solids on nitrogenous ration,	3.61	2.88	2.72
Av. daily yield milk solids on corn meal ration..	2.68	2.07	2.10
Excess with nitrogenous ration................	.93	.81	.62

TABLE XLVII.

RELATION IN QUANTITY OF THE COMPOUNDS OF THE MILK.

Cow A.	Relation of casein to fat. Casein=100.	Relation of fat to total solids. Fat=100.
First period, nitrogenous ration	100:125	100:300
Second period, corn meal ration	100:123	100:315
Third period, nitrogenous ration	100:135	100:299
Cow R.		
First period, corn meal ration	100:117	100:325
Second period, nitrogenous ration	100:130	100:292
Third period, corn meal ration	100:143	100:290
Cow L. T.		
First period, corn meal ration	100:115	100:335
Second period, nitrogenous ration	100:129	100:302
Third period, corn meal ration	100:146	100:300

TABLE XLVIII.

BUTTER CHARACTERISTICS.

Cow A.	Melting point. C°.	Volatile acids.	Iodine equivalent.
First period, nitrogenous ration	33.2	32.9	28.0
Second period, corn meal ration	34.0	29.9	26.7
Third period, nitrogenous ration	33.1	30.1	30.0
Cow R.			
First period, corn meal ration	34.0	32.6	30.0
Second period, nitrogenous ration	33.2	31.4	29.4
Third period, corn meal ration	34.2	32.8	29.6
Cow L. T.			
First period, corn meal ration	31.1	33.2	33.1
Second period, nitrogenous ration	29.3	30.7	24.6
Third period, corn meal ration	30.0	30.8	20.3

The foregoing data, which as stated, are the result of an attempt to study the influence of widely varying rations upon the production and characteristics of milk, give conclusive evidence in regard to but one of the several points considered. The figures tabulated give information about,

(1) The total and digestible food consumed.

(2) The body weights of the animals.

(3) The milk yield.

(4) The composition of the milk.

(5) The yield of milk solids.

(6) The composition of the milk solids.

(7) Certain chemical and physical characteristics of the butter fat.

A review of these data warrant the following summary:

(1) Milch cows were fed two rations differing widely in the amount of protein which they contained. The hay was the same in both, also the weight of grain, but in one the grain consisted wholly of corn meal while in the other it was made up of cotton-seed, gluten and corn meals in equal parts.

(2) Both rations furnished practically the same amount of digestible material. The proportion of digestible protein was nearly twice as great in the mixed grain ration as in the corn meal ration.

(3) The cows did not vary greatly in body weight, but their general appearance showed less thrift while being fed the corn meal ration.

(4) The yield of milk from the nitrogenous ration was from one-fifth to more than one-third larger than that from the corn meal ration, the excess ranging with the three cows from 20 per cent to 36 per cent, or an average of about five pounds of milk per day.

(5) In general the milk was materially richer while the cows were fed the ration rich in protein, though with one cow it showed the largest percentage of solids during the third period while she was eating the corn meal ration. With the other two cows the influence of the mixture of cotton-seed meal, gluten meal and corn meal in increasing the per cent of solids of the milk seemed quite marked.

(6) The daily yield of milk solids was from thirty to forty per cent greater with the more nitrogenous ration.

(7) The composition of the milk solids seemed to be independent of the ration. In general the proportion of fat increased throughout the experiment without regard to what the cows were fed, and no evidence is furnished in support of the notion that by changing the food it is possible to produce more butter fat without an accompanying increased production of the other milk solids. In other words, it appears that the most profitable food for butter production will also be most profitable for the milk farmer or cheese maker. The relation of fat to the other solids seems to be determined by the animal or by certain unknown conditions of environment rather than by the food.

(8) So far as could be learned by chemical tests, the butter made from the two rations was not greatly different.

FEEDING EXPERIMENTS WITH SWINE.

More or less experimental feeding with swine has been going on at the station since the last report that was made of similar work in 1890. These experiments have been practical rather than scientific, and have not resulted as satisfactorily in all respects as was desired. They have centered chiefly around two main considerations: First, the relative economic value of several breeds of swine, special attention being paid to the Tamworths, and to a cross of this breed with the Berkshire; second, the relative value of the dry matter of skimmed milk and an equivalent amount of digestible material from some nitrogenous vegetable food.

The Tamworth swine used as a basis of these experiments were a fine pair of these animals presented to the station by J. M. Sears, Esq., of Boston, Mass., to whom the station is greatly indebted. The female has produced several litters of pigs, and certain of these have been used in the feeding tests. Crosses have also been secured by the use of the Tamworth male and Berkshire females, and as will be seen by the results obtained, these animals have proved to be desirable.

Three lots of animals have been grown from young pigs to a marketable condition. The first lot included Cheshires, Jersey Reds and White Chesters, the second lot Tamworths and Tamworth-Berkshires, and the third lot Tamworths, Berkshires and Tamworth-Berkshires.

The first lot lived mostly in pens out of doors, having shelter from inclement weather. The other lots were grown in indoor pens.

A careful record of food consumed and weights of animals was kept. The food was weighed daily and the animals once a week.

The foods were not analyzed, but are assumed to have the average composition, which for milk and grains may be safely regarded as involving only a small error.

By the use of the figures given in Jenkins' and Winton's tables, and of digestion co-efficients selected from American and German work, the following percentages of digestible material are found to be contained in the food used in these experiments, and these percentages have been applied in calculating the digestible organic nutrients actually consumed.

TABLE XLIX.

COMPOSITION OF FOODS USED IN FEEDING EXPERIMENTS WITH SWINE.

	Dry matter in 100 pounds.	Digestible nutrients in 100 pounds.			
		Total organic matter.	Protein.	Carbo-hydrates.	Fats.
Corn meal	89.4	80.8	8.8	74.3	3.85
Fancy middlings	89.3	67.3	12.0	53.6	3.2
Gluten meal	90.4	82.5	25.3	49.8	4.85
Mangolds*	11.7	9.0	.93	8.1	.12
Oats (ground)	89.0	60.2	9.1	47.2	4.15
Pea meal	89.5	79.2	17.8	59.4	.59
Skimmed milk	10.0	9.2	3.5	5.2	.5
Sugar beets*	16.2	15.0	1.42	13.4	.07

* Actual analyses were made of these materials.

In the tables which succeed, may be found a statement of the results of these experiments.

TABLE L.

EXPERIMENT OF 1891 WITH SWINE.

	White Chester.	Jersey Red.	Cheshire.
Number of animals	2	2	1
Days fed	140	157	157
Skimmed milk consumed*	1800	1884	1256
Middlings consumed	1056	1123	663
Total dry matter consumed	1123	1191.2	717.6
Digestible protein consumed	189.7	200.7	123.5
Digestible carbohydrates consumed	659.5	699.9	420.7
Digestible fats consumed	42.8	45.3	27.5
Total digestible matter consumed, (organic)	892.0	945.9	571.7
Dry matter consumed daily	4.01	3.79	4.57
Digestible organic matter consumed daily	3.18	3.01	3.64
Initial weight of pigs	129	114	82
Last weight of pigs	449	437	265
Total gain of pigs	320	323	183
Daily gain of pigs	1.15	1.03	1.16
Digestible organic matter eaten per pound of gain	2.78	2.93	3.12

* All figures representing weights are in pounds.

TABLE LI.

EXPERIMENT OF 1891–2.

Early Growth of Tamworths and Tamworth-Berkshires.

	Lot 1. Skimmed milk with grain.		Lot 2. Grain ration, no milk.	
	Tamworth pigs.	Tamworth-Berkshire pigs.	Tamworth pigs.	Tamworth-Berkshire pigs.
Number of animals	2	3	2	2
Days fed	126	98	126	98
Skimmed milk consumed	2,506	2,184		
Corn meal consumed	211.0	273.0	254.5	
Sugar beets consumed	422	-	427	
Mangolds consumed	–	294	–	196
Gluten meal consumed	–	–	254.5	
Peas consumed	–	–	–	182.5
Oats consumed	–	–	–	182.5
Dry matter consumed	507.7	496.8	527.5	348.5
Dry matter consumed daily	2.01	1.69	2.09	1.78
Digestible protein consumed	112.3	103.3	92.5	51.1
Digestible carbohydrates consumed	328.2	319.3	354.4	210.2
Digestible fats consumed	20.9	21.5	22.4	8.9
Digestible organic matter consumed	461.4	444.1	469.3	270.2
Digestible organic matter consumed daily	1.85	1.52	1.90	1.39
Initial weight of pigs	73.0	81.0	75.0	53.0
Last weight of pigs	217.0	260.0	199.0	132.0
Total gain of pigs	144.0	179.0	124.0	79.0
Daily gain per pig	.57	.61	.48	.40
Digestible organic matter eaten for each pound of gain	3.18	2.48	3.78	3.42

TABLE LII.

EXPERIMENT 1891-2, (Continued).

Later, Growth Tamworths, and Tamworth-Berkshires.

	Lot fed more skim-milk.	Lot fed less skim-milk.
Number of animals	2	2
Days fed	148	148
Skimmed milk consumed	4,116	2,058
Corn meal consumed	1,435	1,435
Pea meal consumed		147
Oat meal consumed		147
Dry matter consumed	1,694.5	1,750.9
Dry matter consumed daily per pig	5.72	5.91
Digestible protein consumed	271	238.7
Digestible carbohydrates consumed	1,175.4	1,225.1
Digestible fats consumed	75.8	72.5
Digestible organic matter	1,522.2	1,536.3
Digestible organic matter fed daily per pig	5.15	5.20
Initial weight of pigs	208	218
Last weight of pigs	676	691
Total gain	468	473
Daily gain per pig	1.58	1.60
Digestible organic matter eaten per pound of gain	3.26	3.27

TABLE LIII.

EXPERIMENT 1892.

Period 1. Food, Skimmed Milk and Ground Oats.

	Tamworth.	Berkshire.	Tamworth-Berkshire.
Number of animals	4	4	4
Days fed	112	112	112
Skimmed milk consumed	1,792	1,792	1,792
Oat meal consumed	855	1,039	855
Dry matter consumed	940.1	1,103.9	940.1
Dry matter consumed daily per pig	2.10	2.46	2.10
Digestible protein consumed	140.5	157.2	140.5
Digestible carbohydrates consumed	496.8	583.6	496.8
Digestible fats consumed	43.9	52	43.9
Digestible organic matter consumed	681.2	792.8	681.2
Digestible organic matter consumed daily per pig	1.53	1.76	1.53
Initial weight of pigs	74	110	65
Last weight of pigs	397	470	400
Total gain	323	336	335
Daily gain per pig	.72	.75	.75
Digestible organic matter eaten for each pound of gain	2.11	2.36	2.03

TABLE LIII—CONTINUED.

Period 2. Food, Skimmed Milk, Pea Meal and Corn Meal.

	Tamworth.	Berkshire.	Tamworth-Berkshire.
Number of animals	4	4	4
Days fed	42	42	42
Skimmed milk consumed	672	672	672
Pea meal consumed	172.6	200.6	172.6
Corn meal consumed	345.4	401.4	345.4
Dry matter consumed	530.3	605.4	530.3
Dry matter consumed daily per pig	3.15	3.60	3.15
Digestible protein consumed	84.6	94.5	84.6
Digestible carbohydrates consumed	368.5	422.6	368.5
Digestible fats consumed	17.8	20.1	17.8
Digestible organic matter consumed	470.9	537.2	470.9
Digestible organic matter consumed daily per pig	2.80	3.20	2.80
Initial weight of pigs	399	470	400
Last weight of pigs	544	611	546
Total gain	147	141	146
Daily gain per pig	.87	.84	.87
Digestible organic matter eaten for each pound of gain	3.20	3.80	3.20

TABLE LIII—CONTINUED.

Period 3. Food, Mixture Equal Parts Pea Meal, Oat Meal and Corn Meal.

	Tamworth.	Berkshire.	Tamworth-Berkshire.
Number of animals	3	3	3
Days fed	63	49	63
Pea meal consumed	371	253	371
Oat meal consumed	371	253	371
Corn meal consumed	371	253	371
Dry matter consumed	993.0	677.8	993.0
Dry matter consumed daily per pig	5.25	4.61	5.25
Digestible protein consumed	131.4	90.3	131.4
Digestible carbohydrates consumed	643.4	439.5	643.4
Digestible fats consumed	31.3	22.	31.3
Digestible organic matter consumed	806.1	551.8	806.1
Digestible organic matter consumed daily per pig	4.27	3.77	4.27
Initial weight of pigs	438	507	439
Last weight of pigs	638	601	668
Total gain	200	94	229
Daily gain per pig	1.06	.64	1.21
Digestible organic matter eaten for each pound of gain	4.03	5.87	3.52

TABLE LIII—CONCLUDED.

Period 4. Food, Skimmed Milk, Oat Meal and Corn Meal.

	Tamworth.	Berkshire.	Tamworth-Berkshire.
Number of animals	3	3	3
Days fed	56	63	49
Skimmed milk consumed	1,680	1,890	1,470
Oat meal consumed	476.0	402.5	416.5
Corn meal consumed	476.0	402.5	416.5
Dry matter consumed	1,017.0	907.1	891.7
Dry matter consumed daily per pig	6.07	4.94	6.06
Digestible protein consumed	144.5	138.3	126.5
Digestible carbohydrates consumed	631.0	556.5	553.2
Digestible fats consumed	46.4	41.5	40.7
Digestible organic matter consumed	821.9	736.3	720.4
Digestible organic matter consumed daily per pig	4.89	4.01	4.90
Initial weight of pigs	638	601	668
Final weight of pigs	834	801	847
Total gain	196	200	179
Daily gain per pig	1.17	1.06	1.22
Digestible organic matter eaten for each pound of gain,	4.19	3.80	4.02

SUMMARY.

Number of days fed	273	266	266
Digestible organic matter consumed	2,780	2,618	2,678
Total gain	866	771	894
Digestible organic matter for each pound of gain	3.21	3.40	3.00

RELATIVE GROWTH OF ANIMALS OF THE SEVERAL BREEDS.

The only fair comparison of the economy of production with animals from the several breeds is based upon the digestible food consumed for each pound of growth. The figures showing this have been brought together from the foregoing tables and can be seen in table 54.

TABLE LIV.

RELATION OF FOOD TO GROWTH.

(Pounds digestible organic material for each pound gain.)

	Cheshire.	Poland China.	Yorkshire.	White Chester.	Jersey Red.	Berkshire.	Tamworth.	Tamworth-Berkshire.
Experiment—1890	2.88	2.73	2.50	2.50	–	2.45		
1891	3.12	–	–	2.78	2.93			
1891–2, early growth..	–	–	–	–	–	–	3.18	2.48
1891–2, later growth ..	–	–	–	–	–	–	3.71	2.89
1892, period 1	–	–	–	–	–	2.36	2.11	2.03
1892, period 2	–	–	–	–	–	3.80	3.20	3.20
1892, period 3	–	–	–	–	–	5.87	4.03	3.52
1892, period 4	–	–	–	–	–	3.80	4.19	4.02
1892, av. four periods,	–	–	–	–	–	3.40	3.21	3.00

These experiments furnish no evidence of the superior producing capacity of any one of the breeds tested. It should be observed that with the exception of the Tamworths, Berkshires and the Tamworth-Berkshire cross the number of animals grown was too small to allow conclusions of much value.

It is certainly true of the Tamworth-Berkshire cross that the animals were finely formed and vigorous, and they certainly used food more economically than either the pure bred Tamworths or Berkshires. This cross has been admired by all who have seen it, and the market quality of their carcasses was highly commended.

BUTCHERS' ANALYSIS OF THE CARCASSES.

It is evident that the present demands of the market are for pork of a somewhat different kind than was the case formerly. Now the retail meat trade calls for a rather small carcass that will cut a large proportion of lean parts, and as the lean cuts bear a higher

price than "clear pork" it is for the interest of both farmer and dealer that animals be grown which will supply the requirements of the market. Farmers are surely making a mistake in supposing that the fattest animals are certainly the most profitable. It is at least true that such animals tend to aggravate rather than amend the unbalanced diet to which Americans are so much given.

It was hoped that in the Tamworths would be found a breed of swine which with the use of proper rations would furnish to consumers a larger proportion of lean meat than is the case with the breeds more commonly in use, and in order to learn whether this hope would be realized a butcher's analysis has been made of the carcasses of several lots of animals, including five pure breeds and one cross. The most reliable comparison is that made between the Tamworths, Berkshires and the Tamworth-Berkshire cross. The results of this analysis can be seen in Table LV.

TABLE LV.

BUTCHER'S ANALYSIS OF THE CARCASSES.*

	Dressed weight, pounds.	Weights of separate parts,—pounds.							Per cent of lean cuts.	Per cent of salting pork.
		Hams.	Shoulders.	Spare-ribs.	Breakfast bacon.	Leaf lard.	Head and feet.	Salting pork.		
Cheshire	200	28.5	12	50	–	11	19	–	45	
Chester	171.5	25	13	44	–	7.7	21.5	–	48	
Jersey Red	172.5	25	9	38	–	11.5	18.75	–	41.7	
Berkshire	187	26	12.5	46.2	–	8.5	20	–	45.3	
Berkshire	233	33.5	19.5	48	19	14	22.5	76.5	43.3	32.8
Berkshire	199	31.5	17.5	33	12.5	12.5	18	74.3	41.1	37.3
Berkshire	215	30.5	19.7	49	13.5	12.5	18.2	71.6	46.1	33.3
Average	–	–	–	–	–	–	–	–	43.4	34.4
Tamworth	235	33.7	22.5	58	24.5	13	23	60.3	48.6	25.6
Tamworth	281	38.5	19.5	58.5	22.5	17.7	28.5	95.8	41.4	34.1
Tamworth	236	33.5	20	51	13.2	18.2	21.2	78.9	44.3	33 4
Tamworth	227	32.5	18	47.2	15.2	15	21.2	77.9	43	34.3
Tamworth	208	30.2	18.5	44	12.7	15.2	21	66.3	44.6	31.9
Average	–	–	–	–	–	–	–	–	44.4	31.9
Tamworth-Berkshire	341	43	24	67.5	27.5	21	27.2	130.8	39.4	38.4
Tamworth-Berkshire	292.5	38	25.7	62.5	29.5	16.2	23	97.6	43.2	33.4
Tamworth-Berkshire	234	29.5	20.5	49.7	12.5	16.2	18.2	87.4	42.6	37.3
Tamworth-Berkshire	228	31	18	50	12	15	18.2	83.8	43.4	36.8
Average	–	–	–	–	–	–	–	–	42.1	36.5

* These pigs were cut up and the parts weighed by Charles York & Co., Bangor, Me., to whom the Station is greatly indebted for this service.

The above figures show the proportional amount of lean cuts in the several animals. The term "lean cuts" is taken to mean the sum of the hams and shoulders trimmed and the spare-ribs.

The data here presented do not warrant the claim that any one of the breeds compared possesses superior market qualities over all the others. The Tamworth's gave a somewhat larger percentage of lean cuts and the Tamworth-Berkshire cross a larger proportion of salting pork. The differences are small, we may believe, compared with those which may be caused by age, food, or individual variations.

THE RELATIVE VALUE OF DIGESTIBLE FOOD FROM ANIMAL AND FROM VEGETABLE SOURCES.

The report of the Maine Experiment Station for 1889 contains an account of experiments which had for their object, in part, a comparison of the dry matter of skimmed milk with the digestible part of pea meal as food for swine. Those experiments indicated a practical equivalence, pound for pound.

This matter has again been brought to a practical test in the experiments now under discussion. The growth of separate lots of pigs, selected from the same litter, and of the same lots of pigs during separate periods, has been compared when fed rations containing practically the same amount of digestible matter, but which was derived from unlike sources. As in the experiments of 1889, pea meal or oat meal was made to take the place of skimmed milk in the proportion of the digestible substance in the two.

In tables LVI and LVII are presented the figures showing the actual food required for a pound of growth.

TABLE LVI.

EXPERIMENT IN WHICH THE SKIMMED MILK WAS REPLACED BY NITROGENOUS FOODS, WHOLLY OR IN PART.

	Digestible organic food consumed for each pound of gain in live weight.		
	Tamworths.	Tamworth-Berkshires.	Mixed lot of Tamworths and Tamworth-Berkshires.
Lot 1—Growth from one to four months.			
Food, skimmed milk, corn meal and beets	3.18	2.48	
Food, gluten and corn meal and beets	3.78		
Food, pea meal, oat meal and beets		3.42	
Lot 2—Growth from four to nine months.			
Food, skimmed milk* and corn meal			3.26
Food, skimmed milk† pea meal, oat meal and corn meal			3.27

*Amount of milk daily, thirty pounds.

†Amount of milk daily, fifteen pounds. Part only of the skimmed milk was replaced by the pea and oat meals.

TABLE LVII.

EXPERIMENT IN WHICH ONE RATION CONTAINED PEA MEAL IN THE PLACE OF SKIMMED MILK IN THE OTHER RATION.

	Digestible organic food consumed for each pound of gain in live weight.		
	Tamworths.	Berkshires.	Tamworth-Berkshires.
Growth from 1 to 4½ months. (Period 1.)			
Food, skimmed milk and ground oats	2.11	2.36	2.03
Growth from 4½ to 6 months. (Period 2.)			
Food, skimmed milk, pea meal and corn meal	3.20	3.80	3.20
Growth from 6 to 8½ months. (Period 3.)			
Food, equal parts pea meal, oat meal and corn meal.	4.03	5.87	3.52
Growth from 8½ to over 10 months. (Period 4.)			
Food, skimmed milk, oat meal and corn meal	4.19	3.80	4.02

It is very plain that for young pig the rations containing skimmed milk proved superior to those containing the nitrogenous vegetable foods as a substitute. But with the older animals the substitution of pea meal or pea and oat meal for the skimmed milk, wholly or in part, did not materially change the rate of growth or its relation to the digestible food consumed.

In a single case an exception occurs, viz: Period 3 with the Berkshires in the 1892 experiment, where the pure grain ration seemed to check the growth of the pigs. In all other cases the amount of digestible food seems to be the practical measure of efficiency whether its source be animal or vegetable.

Second Series Bulletin No 5

WASTE OF FAT IN SKIMMED MILK BY THE DEEP-SETTING PROCESS.*

W. H. Jordan and J. M. Bartlett.

The relative economy of the various methods of creaming milk is a matter which is just now receiving much attention from Maine dairymen. The question which is most frequently asked, especially by those keeping a fairly large herd of cows, is, "Shall I get a separator?"

In comparing the separator with the cold deep-setting process several points demand consideration:

1st. The relative expenditure of money, time and labor.
2d. The relative waste in the skimmed milk.
3d. The relative waste in the buttermilk.
4th. The comparative quality of the product.

Present knowledge leads to the opinion that the cream can be handled with equal economy from the two methods, and that there is not difference enough between well made separator-cream butter and equally well made cold-setting-cream butter to find any practical recognition in the most particular market.

The first two points, then, are the ones concerning which there is still more or less discussion.

*The matter presented under this head is prepared to be issued as Bulletin No. 5, second series.

The object of this bulletin is to present certain facts, lately ascertained by the Station, bearing upon the second point. These facts were obtained as follows: A representative of the Station, Mr. Hayes, during a certain part of August, September and October last, accompanied the cream collectors of two butter factories, viz: the Turner Centre Factory and the Poland Factory, on their trips to the houses of the patrons, and thoroughly sampled the skimmed milk from twenty-four hours' milk. These samples, which were kept sweet by means of a preservative, were promptly shipped to the Station laboratory, where the per cent of fat was determined. The Turner Factory patrons were visited between August 24th and September 9th, and the Poland Factory patrons, between September 30th and October 10th. Besides the names and addresses of the patrons, Mr. Hayes noted other data, which, when summarized, give the following figures:

No. of farms visited	224
No of cows then milked	1,360
Quarts of milk produced	7,623
No. of herds full-blooded Jerseys	6
" " " grade Jerseys (occasional full-bloods,)	167
" " " full-blood Holsteins	2
" " " grade Holsteins	1
" " " miscellaneous (mixtures of Jersey and other grades, &c.,)	52
" " farms using deep setting process	221
" " " " separator	1
" " " " shallow pans	2
" " " with ice constantly in tanks	194
" " " out of ice	16
" " " using some ice	5
" " " no record	6

Doubtless some will remark that neither the number of cows kept nor the yield of milk make a very favorable showing for Maine dairymen. It should be remembered, however, that these farms were visited at a season of the year when there would probably be found more dry cows and more in an advanced stage of lactation than at any other time. Besides, a severe drought rendered the past season a particularly unfavorable one.

In regard to the methods of creaming, it appears that but one separator was found, while 221 out of the 224 farmers are using

the cold deep-setting process. Of these only sixteen are recorded as being out of ice, while one hundred and ninety-four keep ice in the tanks constantly.

The very great prevalence of Jersey blood is another fact worthy of note, showing the tendency of Maine farms, not only towards dairying, but towards a specific purpose, rather than a general purpose. cow.

The prevalence of the Jerseys and the almost universal use of ice in the tanks all the time are two conditions very favorable to the best possible results with the deep setting process. The percentages of fat in skimmed milk from the 224 farms are not given here in detail, only a summary.

Farms with skimmed milk fat .1 per cent. or below.......	41
" " " " " above .1 per cent. and not over .15 per cent.........	67
" " " " " above .15 per cent. and not over .20 per cent...	57
" " " " " .25 per cent................	19
" " " " " .30 per cent.	11
" " " " " .35 per cent............. ..	3
" " " " " .40 per cent..............	6
" " " " " from .5 to .2 per cent... ..	17
Average amount of fat in 100 lbs. skimmed milk (224 farms)........................... .	.239 lbs.
Average amount of fat in 100 pounds skimmed milk excluding seventeen farms where the amount was .5 pounds or over (207 farms)................	.182 lbs.
Average amount of fat in 100 pounds skimmed milk Turner Centre Factory (157 farms)	.188 lbs.
Average amount of fat in 100 pounds skimmed milk Poland Factory (66 farms)	.357 lbs.
Average for Turner Factory excluding 6 farms over .5 pounds..................................	.168 lbs.
Average for Poland Factory excluding 11 farms over .5 pounds.......	.222 lbs.

The above figures are certainly somewhat surprising. They are much more favorable to the cold deep setting process than any heretofore published, of which the writer is aware, and somewhat diminish the argument for the separator, in so far as it pertains to the prevention of waste in the skimmed milk. One hundred and sixty-

five of the two hundred and twenty-four herds tested did not exceed .2 per cent. of fat in the skimmed milk, the average being about .15 per cent. By the use of the separator on these farms not over .05 per cent. fat would be saved, or one pound of butter fat to two thousand pounds of skimmed milk, *provided the deep setting process is as successfully used all the time.* It is not claimed that the work of the deep setting process is always as good as this. The facts are stated simply as they are found.

It appears that in seventeen cases the per cent. of skimmed milk fat ranged from .5 to 2. In many instances there appears to be a sufficient cause for this excessive loss. In ten of these cases the supply of ice was exhausted, in one the breed of cows was possibly not adapted to the closest deep-setting creaming, in one instance the cream was taken by "top-skimming" which may easily involve unusual loss, and in five instances the conditions were good, there being no apparent reason for abnormal waste.

IS IT NECESSARY TO SUBMERGE THE CANS?*

In the use of the Cooley tank and cans in our own private dairy operations, our philosophy has not considered it necessary that the cans be submerged in order to secure the cleanest practicable creaming, care only being taken that the iced water be kept above the height of the milk in the cans. Seeing the statement in one of our exchanges that the dairymen at the Connecticut convention jumped on to the claim made by Professor Jordan, that the submergence was not absolutely necessary to good work, for they had proved to the contrary, we at once applied to Professor Jordan to learn whether experiments conducted by him had shown that we, and others following the same method, were losing cream by such practice. In reply he has kindly furnished data on the matter, which we give to the readers of the *Farmer* for their benefit.

PROFESSOR JORDAN'S REPLY.

Two reasons are directly or indirectly put forward why submerging should be secured:

1. The composition of the cream is more uniform when this is done.

---

*The following discussion of this question appeared in the *Maine Farmer* on March 1st, 1894, and as it is a matter closely related to the cold setting process for raising cream, and as the data on which the discussion is based was obtained in connection with that presented on the foregoing pages, the liberty is taken to reprint the *Farmer* article in this connection.

2. Less fat is left in the skimmed milk than otherwise would be the case.

No experimental evidence is at hand to show whether the first claim is in accordance with fact or not. The only possible reason that can be offered, however, why submerging affects the consistency of cream, is that it prevents evaporation and consequent thickening of the surface of the cream. But when the cans are in a closed cabinet, the air over the water must be so saturated with moisture as to preclude evaporation from the cream, even if the cans are not submerged. But this point is scarcely worth arguing, for other unavoidable conditions so influence the composition of cream as to completely overshadow this in effect.

The second claim is the more important, and concerning which a certain amount of data is fortunately available.

As was stated in Bulletin No. 5, just issued from this Station, and published in the *Farmer*, a representative of the Station visited two hundred and twenty-four farms, supplying milk to two creameries, and took samples of the skimmed milk. Among other data he noted the manner of setting the milk, whether ice was in the tanks, whether the cans were submerged or not, and if not, the depth of the water.

In making up the averages presented herewith, it should be stated that the first twenty-five farms are excluded, as no record was made of the depth of the water. There are also excluded a few cases where top skimming was practiced, because uniform conditions should prevail in such a comparison. Again, the cases where no ice was used, or other unfavorable circumstances existed, are not included. With these exceptions, the figures obtained are as follows:

Number of observations made	163
Number with cans submerged or sealed	124
Number with cans not submerged or sealed	39
Per cent skimmed milk fat in submerged or sealed cans	.173
Per cent skimmed milk fat in cans not submerged or sealed	.200

The difference is slightly in favor of submerging, but is not large enough to have any practical importance.

It is noticeable in looking over the records mentioned in the foregoing, that a greater percentage of Jerseys and Jersey grades were found among the patrons of the Turner factory than among those of

the Poland factory, the latter owning a somewhat larger proportion of Shorthorn and Holstein grades. For this reason it is possibly more just to compare results among the patrons of the same factory, especially as the "not submerged" cases were more frequent in one case than in the other:

TURNER FACTORY.

Number patrons with cans submerged or sealed	106
Number patrons with cans not submerged or sealed	13
Per cent skimmed milk fat in submerged or sealed cans ..	.169
Per cent skimmed milk fat in cans not submerged or sealed..	.177

POLAND FACTORY.

Number patrons with cans submerged or sealed	18
Number patrons with cans not submerged or sealed	26
Per cent skimmed milk fat in cans submerged or sealed.. ...	.201
Per cent skimmed milk fa tin cans not submerged or sealed..	.211

The records show that where the cans were not submerged or sealed, the depth of water varied from half the height of the can to a level with the handles. Mr. Hayes states that the purpose seemed to be to have the water as high as the milk, or above.

The value of submerging as a means of decreasing the waste of fat in the skimmed milk does not become apparent through the foregoing figures. It should be remembered, however, that in all these cases ice was used and kept in the tanks all the time. If this were not done, the chances would appear to be in favor of submerging, because the greater the volume of water, the less its temperature would be raised by cooling the warm milk.

W. H. JORDAN.

Maine Experiment Station, February 14, 1894.

REPORT OF THE HORTICULTURIST.

W. M. Munson.

Many of the experiments detailed in the following report are repetitions or continuations of those undertaken in previous years. The conclusions reached, though sometimes contradicting those heretofore drawn, are none the less valuable. They are the result of careful study of the problems, and as stated in other connections, conclusions are too often freely drawn from insufficient data.

The cauliflower has been added to the list of vegetables receiving special attention, and our success, from a practical point of view, would indicate that the crop may be profitably grown in this section of the state.

The fruit plantation is not as yet in full bearing, and notes concerning the comparative merits of varieties are reserved for a future report. Several additions were made to the orchard, also to the collection of small fruits, during the past season. Despite the cold winter of 1892-3, very little damage was noticed in our plantations.

Spraying experiments were continued on the lines detailed in my last report. The results obtained, as heretofore, point strongly to the value of the use of the copper solutions in combatting the apple scab. The most valuable preparation yet used is the Bordeaux mixture. We are under special obligations to Mr. Charles S. Pope of Manchester, for the continued use of his orchard and the careful attention given in carrying into effect the instructions of the writer.

Included in this report is a catalogue of the fruits of the state with the approximate value of each. This catalogue is presented only after careful study of the reports of many of the leading fruit growers in different sections of the state, in response to a series of questions sent out by the writer. It will be found valuable for reference in the selection of fruits for general planting.

I wish to make special mention of the careful and efficient work of my assistant, H. P. Gould.

I—Notes of Cabbages.

As heretofore our work with cabbages was confined to a few questions relative to methods of culture. In all cases the seed was sown in the forcing house April 3d, and the young plants were pricked out

into boxes April 24th. The season was exceptionally late and a second handling was necessary, May 17th, before the final transfer to the field May 30th.

"All Head Early" and "Burpee's Safe Crop," two sorts sent for trial by W. Attee Burpee & Co., of Philadelphia, are of the Flat Dutch type. They did not average quite so large nor so early as Early Flat Dutch, but were very uniform in size, of firm texture, and produced a high percentage of marketable heads.

1. *Influence of Transplanting*: For two seasons an experiment has been conducted for the purpose of ascertaining whether plants handled in pots previous to setting in the field, are enough superior to those handled in boxes, to warrant the increased expense.* In 1891 the results were indifferent, while last year indications were strongly in favor of the pot-grown plants. The treatment of the plants was in every respect similar to that given last season, *i. e.* one lot of twenty-five young plants was transferred from the seed flat to three-inch and later to four-inch pots, while a duplicate lot was placed in shallow boxes—two inches apart at the first handling and four inches apart at the second.

The results obtained are shown in table I.

TABLE I.

CABBAGE PLANTS FROM POTS AND BOXES.

Variety and Treatment.	Heaviest head—lbs.	Lightest head—lbs.	Average weight—lbs.	Number of heads cracked.	Number of heads immature.	Failed to head.	Ratio.	Remarks.
FLAT DUTCH.								
Pots	15.2	8.9	**10.7**	3	0	0	**1.23**	All cut Aug. 18
Boxes	12.0	2.9	**8.7**	0	1	2	**1.00**	
SAFE CROP.								
Pots	10.0	5.5	**7.4**	0	0	1	**1.34**	
Boxes	9.2	2.4	**4.9**	0	11	2	**1.00**	
ALL-HEAD EARLY.								
Pots	12.0	2.8	**8.3**	1	0	0	**1.60**	
Boxes	8.0	1.1	**5.2**	0	1	0	**1.00**	

*Report Maine Experiment Station, 1891, p. 84; 1892, p. 61.

As will be seen at a glance plants handled in pots were, in every respect, superior to those from the boxes; thus confirming results obtained last year. In no case did the plants from boxes produce heads equal to the best of those from pots.

Conclusion: The practice of handling cabbage plants in pots previous to setting in the field would seem to be warranted by the results obtained during the past two seasons.

2. *Effects of Trimming:* A test as to the value of the practice of reducing the amount of foliage at time of setting was conducted along the same lines as last season.* The results as shown by table II are almost identical with those obtained in the previous trial.

TABLE II.

EFFECTS OF TRIMMING.

VARIETY.	Number of heads.	Heaviest head—lbs.	Lightest head—lbs.	Average weight—lbs.	Number of heads cracked.	Number of heads immature.	Number of plants not cut.	Ratio.	Date of harvesting.
EARLY SUMMER.									
Trimmed	9	10.0	4.0	**7.9**	4	2	1	**1.23**	Sept. 1.
Not trimmed	8	9.4	3.1	**6.4**	2	2	1	**1.00**	Sept. 1.
WORLD BEATER (Brill).									
Trimmed	7	13.3	6.9	**9.5**	1	0	1	**1.00**	Sept. 12.
Not trimmed	7	14.7	3.5	**9.5**	2	1	1	**1.00**	Sept. 12.
WORLD BEATER (Burpee).									
Trimmed	19	15.7	3.3	**9.9**	0	0	2	**1.00**	Sept. 12.
Not trimmed	13	16.0	6.2	**11.1**	3	0	1	**1.12**	Sept. 12.

As will be observed, the results are almost negative. The first variety, Early Summer, exactly reverses the result given last season, when the ratio was as 1.00 : 1.23 in favor of plants not trimmed. In case of World Beater (Brill) the ratio was neutral as in 1892. The plants used in this test were from the same lot of seed as those grown last year. The third variety gave results slightly in favor of plants not trimmed.

*Report Maine Experiment Station 1892, p. 60.

Conclusion: The results of two seasons' work indicate that little advantage is derived from the practice of trimming cabbage plants at time of setting.

3. *Holding Plants in Check*: Frequently, because of an unusually late season, or from other unavoidable circumstances growers are unable to set plants in the field as soon as they might desire, or when the plants are ready for the transfer. Such conditions existed in our own experience the present year and to meet the case in hand, at the last handling in the house, May 17, all plants except some for checks were severely headed back. What the usual result might be of course we are unable to say, but indications are certainly favorable to the practice. Our general crop was uniformly good. The results of careful comparison of plants thus treated with others of the same lots not checked are given in table III.

TABLE III.

CHECKING GROWTH.

Variety.	Heaviest head—lbs.	Lightest head—lbs.	Average weight—lbs.	Number of heads cracked.	Number of heads immature.	Number of heads not cut.	Ratio.	Date of harvesting.
All Head (Burpee's).								
Checked	12.0	2.8	**8.3**	1	0	0	**1.14**	August 18.
Not checked	11.6	3.3	**7.3**	0	0	0	**1.00**	August 18.
Flat Dutch.								
Checked	15.2	8.9	**10.7**	3	0	0	**1.09**	August 19.
Not checked	13.2	5.6	**9.8**	1	0	0	**1.00**	August 19.
Safe Crop (Burpee's).								
Checked	10.0	5.5	**7.4**	0	0	1	**1.00**	August 18.
Not checked	10.2	6.4	**8.6**	0	0	1	**1.16**	August 18.
Red.								
Checked	13.2	5.3	**8.0**	2	0	1	**1.13**	September 12.
Not checked	11.3	1.3	**7.1**	1	2	0	**1.00**	September 12.

In most cases plants headed back at the last transplanting in the house were superior to those not thus checked. They were uniformly earlier, and were as a rule slightly larger. It is probable that

the time elapsing between the check and the transfer to the field allowed the plants to recuperate and make a sturdy growth; while plants not treated were necessarily more or less drawn and not in as good condition for the final transfer.

Conclusion: Cabbage plants likely to become drawn and crowded before planting out, appear to be benefited by severe pruning of the foliage.

II—Notes of Cauliflowers.

The cauliflower is a vegetable highly prized by many, but is too seldom met in the home gardens of our State. Possessing many of the good qualities of the cabbage it is, to a certain extent lacking in the peculiar rank flavor which renders the former disagreeable to many people. The delicate qualities of the cauliflower are, however, frequently disguised or lost through failure of the housewife to familiarize herself with the best methods of serving. For this reason we have given below some notes concerning the cooking of cauliflowers, condensed from material kindly furnished by Miss Anna Barrows, School of Domestic Science, Boston.

1. *Directions for Serving the Cauliflower:* A cabbage or cauliflower, unless taken directly from the garden is much improved if so placed that it can absorb water through its stalk for twelve to twenty-four hours before cooking. Soak a cauliflower, head down, in cold salted water for an hour before cooking to draw out any insects that may be concealed. A small cauliflower may be cooked whole and should be placed in the kettle with the flowerets up as the stalk needs the most thorough cooking; a large head should be divided into six or eight pieces.

Cook in a kettle of rapidly boiling salted water, to which may be added one-fourth of a level teaspoonful of soda. (The soda aids in softening the woody fibre.) The kettle should be skimmed occasionally while the vegetable is cooking, or, to save trouble, some prefer tying the cauliflower in a thin cloth. An agate or porcelain lined kettle is preferable to iron, which is likely to discolor the cauliflower.

The odor is less noticeable if the kettle is left uncovered. The water may also be changed to dispel the odor. A cauliflower should be tender after twenty to thirty minutes of rapid boiling. If overcooked it appears soggy and water-logged.

A good cauliflower, well cooked, requires little additional flavor beside salt and good butter. Some, however, prefer the addition of grated cheese. The cauliflower may also be served as a garnish for meats, in sauces, soups and is excellent cold as a salad. Many prefer it with a thick cream sauce.

"Cold boiled cauliflower is very good fried plain in butter, or breaded and fried, or mashed and fried like oyster plant, with the addition of an egg and a palatable seasoning of salt and pepper."

The last paragraph is from Miss Carson's Practical American Cookery. Many other hints may be obtained from this and other leading guides to cookery.

2. *Culture*: In a general way the culture is the same as for cabbages. Early varieties should be started in the house or hot-bed as soon as the first of April. Handle as needed, and set in the open field as early as possible. The best soil is a rich, moist loam, but it should be well drained. Like the cabbage, the cauliflower is a gross feeder and demands intense culture. If growth is stopped from any cause, the heads are likely to "button" or form small sections interspersed with leaves, worthless for market purposes. Frequent cultivation is necessary, and it is probable that in case of very dry weather about the time of heading, irrigation would be a profitable means of securing a crop for home use at least. When the heads are about three inches across, the outer leaves should be brought together and held in place by means of a piece of twine or raffia, that the heads may be well bleached.

3. *Influence of Early Treatment*: The relative influence of pot and of box culture of young plants was considered with reference to the number of heads produced: Seed was sown April 3d; the young plants were transferred to two and one-half inch pots April 24th; to four inch pots May 10th, and to the field May 29th. A duplicate lot was handled in boxes at the same dates. At the last handling in the house, May 10th, the leaf surface was reduced about one-half. A tabular view of the results is given below:

TABLE IV,

CAULIFLOWERS IN POTS AND BOXES.

VARIETY.	Number heads cut July 26.	Number heads cut August 3.	Number heads cut August 15.	Number heads cut August 28.	Total number heads.	Number of plants.	Per cent of plants forming heads.
DWARF FRENCH, Half Early Dwarf French.							
Pots	1	4	1	0	6	13	**46.2**
Boxes	0	4	1	0	5	21	**23.8**
GILT EDGE (Thorburn).							
Pots	4	9	2	1	16	17	**94.5**
Boxes	2	7	2	1	12	16	**75.0**
PARIS, Extra Early Paris.							
Pots	2	1	0	0	3	17	**17.6**
Boxes	0	0	2	1	3	17	**17.6**
LONDON, Large Early London.							
Pots	0	0	1	10	11	20	**55.0**
Boxes	0	0	3	10	13	21	**61.9**

In two instances there was a difference of twenty per cent in favor of the plants grown in pots. One variety gave the same number of heads in each case but the plants from pots were two to three weeks earlier than the others. The fourth variety gave a slight difference, about seven per cent, in favor of the box treatment. Doubtless any benefit that might arise from handling plants in pots would lie in the fact that the plants are kept at a more uniform rate of growth.

Conclusion: Indications point to an increased percentage of marketable heads as a result of handling cauliflower plants in pots during early stages of growth.

4. *Effects of Trimming:* The value of reducing the amount of foliage at the time of removal to the field with reference to the heading of cauliflower, received some attention. The seed was sown April 3, the young plants were transferred to boxes April 24 and again May 10. All were removed to the field May 29, when the foliage of one lot was reduced by one-half while a duplicate lot was left without trimming.

The table shows the relative earliness and the per cent of heads formed.

TABLE V.

EFFECT OF TRIMMING CAULIFLOWERS.

VARIETY.	Number heads cut July 26.	Number heads cut August 3.	Number heads cut August 15.	Number heads cut August 28.	Number heads cut September 15.	Total number heads.	Number of plants.	Per cent of plants forming heads.
ALABASTER.								
Trimmed	3	4	1	2	–	10	12	**83.3**
Not trimmed	4	5	2	–	–	11	12	**91.7**
ERFURT (Large Early Dwarf).								
Trimmed	–	5	4	1	–	10	13	**76.9**
Not trimmed	–	7	3	1	–	11	13	**84.6**
ERFURT (Ordinary).								
Trimmed	–	4	7	6	–	17	19	**89.5**
Not trimmed	–	7	3	7	1	18	19	**94.7**
PRIZE EARLIEST.								
Trimmed	–	4	2	4	–	10	14	**71.4**
Not trimmed	–	–	5	4	–	9	13	**69.2**
STADTHOLDER.								
Trimmed	–	–	–	3	2	5	10	**50.0**
Not trimmed	–	–	–	3	–	3	9	**33.3**

As a rule, the per cent of heads formed was greater from plants not trimmed. There was practically no difference in the earliness of the two lots, nor was there a marked difference in the size of the heads.

Conclusion; Results obtained will not warrant us in commending the practice of trimming cauliflower plants severely at time of setting in the field.

5. *Varieties:* Nearly all of the more important varieties of cauliflower were grown in our gardens the past season for purposes of comparison. We found, as was expected, a marked variation in different strains of the same type. The accompanying table will give a comprehensive view of the comparative merits of the different strains and varieties as regards earliness, percentage of heads formed, and average weight of heads. The latter quality is necessarily only relative; for a few days time, even after the head is ready for market makes a decided difference in weight.

TABLE VI.

VARIETIES OF CAULIFLOWER.

VARIETY.	Number heads cut July 26.	Number cut August 3.	Number cut August 15.	Number heads August 28.	Number heads September 15.	Number heads after October 1st.	Total number heads cut.	Number of plants.	Per cent of plants forming heads.	Average weight per head—lbs.
Autumn Giant	–	–	–	1	2	2	5	14	35.7	9.7
Best Early (Burpee's)	8	4	2	–	–	–	14	14	100.0	1.9
Dwarf Erfurt, extra early	3	3	5	1	–	–	12	12	100.0	2.8
Dwarf Erfurt, ordinary	–	7	3	7	1	–	18	19	94.7	3.7
Early Alabaster	4	5	2	–	–	–	11	12	91.7	1.3
Early Dwarf Danish	7	12	1	–	–	–	20	20	100.0	2.7
Early Paris	–	2	5	3	–	–	10	13	76.9	2.7
Early Asiatic	–	2	5	3	1	–	11	11	100.0	3.3
Early London	–	–	3	10	–	–	13	21	61.9	3.9
Extra Early Paris	–	–	2	1	–	–	3	17	17.6	0.9
Giant Purple, early	–	–	–	1	2	2	5	15	33.3	4.8
Giant Purple, late	–	–	–	1	2	1	4	16	25.0	7.9
Half Early Dwarf French	–	4	1	-	–	–	5	21	23.8	1.5
Imperial	1	6	2	1	–	–	10	11	90.9	2.6
Italian Taranto	–	–	–	1	3	–	4	22	18.2	6.9
Kronk's Perfection	7	5	3	1	–	–	16	16	100.0	2.2
Landrettis First	–	16	3	1	–	–	20	20	100.0	3.3
Large Late Dutch	–	–	–	2	1	–	3	24	12.5	6.0
Large Algiers	–	–	4	3	–	–	7	14	50.0	2.0
Large Early Dwarf Erfurt	–	7	3	1	–	–	11	13	84.6	2.0
Lenormand's Short Stem	1	–	4	1	–	–	6	18	33.3	1.1
Livingston's Earliest	8	4	1	1	–	–	14	18	77.8	3.2
Long Island Beauty	–	8	7	–	–	–	15	15	100.0	2.3
Nonpareil	–	–	4	5	1	–	10	15	66.7	3.0
Prize Earliest	–	–	5	4	–	–	9	13	69.2	3.2
Stadtholder	–	–	–	3	–	–	3	9	33.3	5.0
Thorburn Early Snowball	2	4	2	3	–	–	11	14	78.6	2.2
Thorburn Gilt Edge	2	7	2	1	–	–	12	16	75.0	0.6
Vaughan's Danish Snowball	2	7	2	1	–	–	12	12	100.0	
Walcheren	–	–	–	2	–	–	2	10	20.0	2.6

As will be seen, nearly all of the earliest varieties produced a high percentage of marketable heads, while the later sorts were anything but satisfactory. Of the whole number of varieties grown sixteen produced more than seventy-five per cent of marketable heads, while with eight varieties, every plant produced a good head. The earliest varieties were Burpee's Best Early, Dwarf Danish, Kronk's Perfection, and Livingston's Earliest. These were closely followed by Alabaster, Landreth's First, Long Island Beauty and several strains of Snowball.

Most of the late varieties were checked by the dry weather and showed a tendency to "button," or go to seed, hence are not considered here.

The following field notes concerning the more important varieties were made

Alabaster: (Johnson & Stokes).—Said to be a sport from *Dwarf Erfurt* (see below). A small early variety. An erect grower and may be planted closely.

Autumn Giant: (Thorburn).—A very large late variety of excellent quality; should not be started so early as most other sorts.

Best Early: (*Burpee's Best Early*, Burpee).—Small, but one of the earliest and surest heading varieties.

Dwarf Erfurt: (Thorburn).—Takes its name from the city of Erfurt, Germany, where cauliflowers are extensively grown. One of the most popular early varieties Several strains were grown this year, of which the best seemed to be Thorburn's Extra Early.

Early Danish: (Farquhar).—Of the Erfurt type; forming a medium sized head, very firm and good. One of the best.

Early Paris (Thorburn, Farquhar).—Moderately vigorous, with long stem and of spreading habit. Leaves covered with heavy bluish white bloom giving the variety a characteristic light shade. Heads of fair size but lacking in solidity.

Giant Purple. (Childs).—A large, late variety, very attractive when growing, and of excellent flavor, but when served its color is objectionable.

Imperial. (Landreth).—A medium sized pure white variety. Of spreading habit and heads not very firm.

Kronk's Perfection. (Farquhar).—A very fine strain of the Erfurt type. Of medium size, early, uniform, and in our plantation was among the best.

Landreth First. (Landreth).—Of vigorous, erect habit, but having a short stem. Heads of medium size, very solid, white, and rather remarkable for uniformity. One of the best.

Livingston's Earliest. (Livingston).—One of the earliest, small but uniform in date of maturity, a valuable consideration in a market variety.

Long Island Beauty. (Gregory).—A valuable second early sort. Only two cuttings were necessary and every plant produced a marketable head.

Prize Earliest. (Maule).—Three weeks later than some of the other varieties. Not satisfactory this season.

Snowball. (*Early Snowball*, Thorburn).—A moderately vigorous variety forming small but very solid heads. From this type many valuable strains have been derived. One of the most valuable of these is the next mentioned.

Thorburn Gilt Edge. (Thorburn).—This variety is not quite so vigorous as the parent, the leaves are slightly smaller and very dense, while the stem is shorter. Heads small but handsome, and usually one of the most reliable.

Vaughan's Danish Snowball. (Vaughan).—Differs little in habit from Snowball described above. Very early and apparently a sure header.

London, Italian Taranto, Late Dutch, Algiers, Nonpariel, Stadtholder and some others while producing very good individual heads, were not reliable, the present season, and notes concerning these are withheld until further trial.

SUMMARY.

1. The general treatment of the cauliflower is similar to that required by cabbages. Thorough and frequent cultivation are essential.

2. Handling plants in pots before setting in the field increased the percentage of marketable heads.

3. Trimming plants at time of setting is of doubtful value.

4. Early varieties are, as a rule, more certain to produce a satisfactory crop than are the late sorts.

5. The earliest varieties grown the past season were: Burpee's Best Early, Dwarf Danish, Kronk's Perfection and Livingston's Earliest; closely followed by Alabaster, Landreth's First, Long Island Beauty and several strains of Snowball. All of these produced a high percentage of marketable heads.

III—Notes of Tomatoes.

As heretofore. special attention was given to methods of culture rather than to a multiplicity of varieties. Many of the experiments undertaken last season were repeated. for as before stated, positive conclusions can not be drawn from a single season's work.

1. *Effects of Early Setting*: A dozen plants of each of three varieties were used in the test. All were given similar treatment in the house. The first lot was removed to the field May 23d. The other a week later Owing to a heavy frost on the night of May 27th the early set plants were severely checked : while the weather for some days was cold and raw. but very dry. In spite of this check the first lot recuperated and by the first of October there was practically no difference in the two lots.

Table VII gives an exact statement of the results :

TABLE VII.

EFFECT OF EARLY SETTING.

Variety.	Date of first ripe fruit.	Average number fruits per plant.	Average weight of fruit per plant—pounds.	Average weight of individual fruits—ounces.	Number fruits per plant before October 1st.	Number decayed fruits per plant before October 1st.	Total number decayed fruit per plant.
Buckeye State.							
First setting	Aug. 9	11.0	6.4	9.3	**6.4**	1.3	**5.8**
Second setting	Aug. 10	8.6	5.3	10.0	**5.7**	2.0	**4.5**
Burpee's Climax.							
First setting	Aug. 4	27.3	8.4	4.9	**19.8**	1.4	7.3
Second setting	Aug. 2	33.6	10.4	4.9	**20.8**	1.2	10.6
Great B. B.							
First setting	Aug. 27	23.9	8.6	5.8	**13.9**	1.3	9.8
Second setting	July 27	29.5	11.0	6.0	**13.4**	1.9	15.5

There was very little difference in the time of ripening of the first fruits : and on the first of October. a date as late as can usually be relied on for tomatoes, there was practically no difference in the number of fruits produced by the two lots. The slight variation found was in favor of the early set plants.

As will be see by the last two columns in the table, the number of decayed fruits was very greatly increased late in the season, amounting in some cases to 75 per cent. of the fruit gathered.

Conclusion: While not so marked as in previous trials, indications still point to the value of early setting of tomato plants.

2. *Value of Pot-Culture*: The importance of careful handling of tomato plants has been emphasized in previous reports, and a limited amount of work has been done in this direction at this station.

During the past season a test of the relative value of pot-culture during the early stages of growth was conducted on lines similar to those detailed on page 102 for cabbage plants. A dozen plants of each of four varieties were transferred from the seed-flats to thumb-pots on April 27th, to three-inch pots May 9th. to four-inch pots May 20th, and to the open ground June 1st A duplicate lot was handled in flats at the same time. The results are shown in table VIII.

TABLE VIII.

VALUE OF POT CULTURE OF TOMATOES.

VARIETY.	Average number fruit per plant.	Average weight of fruit per plant—pounds.	Average weight of individual fruits—ounces.	Average number fruits per plant before October 1st.	Ratio (by number of fruit.)	Bushels per acre, before October 1st.
IGNOTUM.						
Pots	19.0	8.9	7.5	**10.5**	**1.28**	**139.4**
Boxes	12.3	5.9	7.7	**8.2**	**1.00**	**110.3**
ITHACA.						
Pots	23.5	6.7	4.6	**15.8**	**1.42**	**127.8**
Boxes	15.5	4.7	4.0	**11.1**	**1.00**	**98.7**
OPTIMUS.						
Pots	32.0	7.9	3.9	**14.2**	**1.21**	**112.1**
Boxes	16.5	4.3	4.2	**11.7**	**1.00**	**83.0**
STONE.						
Pots	14.3	5.5	6.2	**7.4**	**1.39**	**72.6**
Boxes	9.1	5.1	8.2	**5.3**	**1.00**	**81.3**

In every instance there was a marked increase in the number of fruits from plants handled in pots, and in the total weight of fruit produced. It will be observed, however, that the individual fruits averaged larger on the plants from boxes. This fact is no doubt due to the smaller numbers borne, as before mentioned.

In the last column is given the number of bushels per acre before October 1st, on the basis of the weight of fruit picked at that time, and considering the plants placed five feet apart each way in the field. With one variety the difference is slightly (about 9 bushels per acre) in favor of the box culture. This difference being due to the marked increase in size. But the first three varieties show a difference of more than 29 bushels each, in favor of the pot-grown plants. This difference, at 75 cents per bushel (none of our fruit was sold at less than 60 cents per bushel, and early in the season we received $1.75 at wholesale), would amount to $21.83 per acre, —a sum that would far more than pay for the cost of pots and the slightly increased cost of handling in the house.

Conclusion: There appears to be a marked increase in the productiveness of plants handled in pots previous to setting in the field.

3. *Individual Variation*: The danger from drawing too free conclusions from a single season's work was suggested last year, when it was found that, "In no case were the results from duplicate tests uniform."* A similar test of the variation of duplicate lots of any given variety was conducted the past season. The results bear out our former conclusion to such an extent that results of certain methods of culture undertaken are withheld for further verification.

Table IX shows the comparative results obtained with duplicate lots of each of three varieties, all of which were given the same treatment in house and field.

*Report Maine Experiment Station, 1892, page 64.

TABLE IX.

INDIVIDUAL VARIATION.

Variety.	Average number fruits per plant.	Average weight of fruit per plant—lbs.	Average weight of individual fruits—ounces.	Average number decayed fruits per plant.	Date of first ripe fruit.
Golden Queen	**13.9**	4.5	**5.2**	4.9	August 2.
	19.0	6.6	**5.5**	5.3	August 9.
Rose Peach	**16.6**	3.2	**3.1**	2.3	August 7.
	13.1	2.4	**3.0**	2.7	August 7.
Royal Red	**14.4**	5.6	**6.2**	6.3	August 7.
	15.0	5.8	**6.1**	6.7	August 4.

The weight of individual fruits was practically uniform, but the variation in number of fruits and in the consequent weight of the product was very marked. The date of ripening was also variable.

Conclusion: The individual variation of plants of any given sort is often such as to obscure any effects of different methods of culture. Results previously obtained are confirmed.

4. *Crossing*: Some of our work in developing a tomato which shall be of sufficient earliness to be profitable as a market crop in those sections where the seasons are short, was detailed in our last annual report.* Selections and further crosses were made the present season with interesting and promising results.

The *Lorillard-Peach* cross showed a less marked increase over the pure Lorillard, in number of fruits than was the case in the first generation,—a fact which illustrates the principle frequently laid down that crossing within the limits of the species tends to promote fruitfulness. In the second generation the influence of the male parent on the character of the fruit was shown by several individuals which assumed the peculiar rough skin, and to a certain extent the form of Peach.

*Report Maine Experiment Station, 1892, p. 65.

The *Ignotum-Peach* cross showed a similar falling off in the second generation, as shown below.

IGNOTUM X PEACH.	Average number fruits per plant (both ripe and green.)	Average weight of fruit per plant—pounds.	Average weight of individual fruits—ounces.	Average number fruits ripened.
First generation	191	30.3	2.5	51
Second generation	107	17.4	2.6	35

As will be seen there is a falling off of nearly forty-four per cent in the total number of fruits borne. It is however quite possible that the conditions under which the parents were grown in the two generations may account for some of this variation.

The original parent was grown in the house and was specially cared for. The plants from which the "second generation" in this trial came, were given ordinary field culture, though the ground was rich and the plants were well cared for.

We know that conditions of growth during a single generation, exert a marked effect on the vitality of seeds. This influence, extending further in the life history of the plant, may determine to a certain extent the character of any strain. In this way it would seem possible that by forcing plants to early development in the house and by limiting the amount of fruit borne for a few generations, a strain of unusual vigor may be produced. This question is receiving attention in our houses at the present time.

The result obtained from crossing the *Lorillard-Currant* hybrid described in our last report,* with the female parent—Lorillard—promises valuable results. Naturally the number of fruits is reduced, but the size is fully doubled, while the quality is much improved.

5. *Varieties*: The tomatoes were started in the forcing house March 27th. All varieties were given the same treatment while in the house and were transferred to the open field June 1st. The first ripe fruits were found July 25th, on Golden Ball and Long Keeper. Two days later one or more fruits were gathered from Aristocrat, Great B. B., Ithaca and Maule's Earliest.

*Report Maine Experiment Station, 1892, page 68.

On October 1st, when the season was practically ended, the following varieties were found in the order named, to have been the most productive: Golden Ball, Improved Peach, Maule's Earliest, Burpee's Climax, Lorillard, Ithaca and Belmont. Optimus, which was the most productive sort grown last year stood *ninth* (or dropping the first two varieties which are of value for amateur culture only, *seventh*) in the list the present season.

The large late varieties, such as Belmont, Buckeye State and Stone, decayed very badly late in the season. The same is true to a certain extent of Ignotum, Matchless and Optimus.

Maule's Earliest and Burpee's Climax were both much smoother than is usual with very early sorts, and are promising.

Ithaca and Long Keeper deserve the credit given in previous reports.

Lemon Blush failed to blush and was consequently inferior to Golden Queen.

Buckeye State, Royal Red and Stone, while of merit as individual fruits, are all too late for our short seasons. Ponderosa will be discarded for similar reasons.

Terra Cotta was of very unsatisfactory quality, and is not a firmly fixed variety.

Great B. B., in spite of its name is a fairly good variety. It decayed badly late in the season.

Summary.

1 The conclusions of former years as to the value of setting tomato plants as early in the spring as possible are confirmed.

2. Plants handled in pots previous to setting in the field are more vigorous and productive than those not so handled,—a fact which may be of great importance to the commercial grower.

3. Individual variation is often such as to render the work of any one season unreliable.

4. The productiveness of any given variety may be largely increased by crossing with some of the smaller less valuable sorts. But this increased productiveness may be partially or wholly lost in a few years even if good culture is given. The variety will quickly "run out."

5. It seems possible that seeds from plants grown under high culture in the house may give better results than those from plants not so treated.

6. By combining the Lorillard-Currant hybrid, with the Lorillard, the size has been more than doubled, and the quality is much improved.

7. Of the newer varieties, Burpee's Climax, Maule's Earliest and "B. B." were among the most promising. Buckeye State, Ponderosa, Royal Red and Stone are too late for our climate. Lemon Blush lacked its distinguishing characteristic, and Terra Cotta was of inferior quality.

IV—Notes of Egg Plants.

Our work with egg plants during the past season has been principally confined to methods of culture, including time of setting; deep and surface cultivation; the value of frequent cultivation, the effect of root pruning. In all cases seed was sown March 17. The young plants were pricked out into seed flats April 28; transferred to 4-inch pots May 22, and with the exception of one lot, to the open field June 10.

1. *Value of Early Setting*: The egg plant, being of tropical origin, is very sensitive to sudden changes of temperature. The question has therefore arisen: Will not plants give more satisfactory results if allowed to remain in the house till the season is well advanced, provided they are not checked or crowded?

The writer has usually advocated setting plants about the 10th to the 15th of June, but as bearing upon this point two lots of each of three varieties were given similar treatment during the season, save that one lot was set in the field June 10, and the other June 21, the season being unusually late. The comparative results are shown in table X.

TABLE X.

EARLY *vs.* LATE SETTING OF EGG PLANTS.

VARIETY.	Number of plants.	Number of plants bearing market-able fruits.	Number of market-able fruit.	Per cent of plants bearing market-able fruit.
EARLY DWARF PURPLE.				
Early set	18	18	40	100.0
Late set	15	13	15	86.7
EARLY LONG PURPLE.				
Early set	17	12	30	70.6
Late set	16	10	17	62.5
BLACK PEKIN.				
Early set	18	18	21	100.0
Late set	17	11	12	64.7

It will be observed that in every instance the lot set June 10, produced a larger percentage of plants bearing marketable fruits than did the lot set later. This difference in one case—Black Pekin—amounted to more than 35 per cent. The average number of marketable fruits on the bearing plants was also much larger from those set early. Dwarf Purple produced nearly twice as many fruits from the first lot as from the others.

This difference is due to two causes. Fruits seem to set more freely in the warm days of July and August—hence the desirability of having the plants in full vigorous growth at that time; while the fruits formed later are almost certain to be injured by frost before reaching edible maturity.

Conclusion: The percentage of plants bearing marketable fruits, also the productiveness of individual plants, is considerably less from plants set late in June than from those set earlier.

2. *Deep vs. Shallow Cultivation*: We have always recommended constant cultivation as one of the first requisites to success with egg plants. There is a question, however, whether it is advisable to disturb the roots to so great a depth as is commonly done with the ordinary farm cultivator. As bearing upon this point a

number of plants of each of three varieties were given ordinary deep cultivation, while a duplicate lot, planted by the side of the first was given very shallow cultivation. The first lot was cultivated about once in ten days with a Planet Jr. horse hoe; the second was hoed by hand at the same time.

The results obtained are shown in table XI.

TABLE XI.

DEEP *vs.* SHALLOW CULTIVATION OF EGG PLANTS.

Variety.	Number of plants.	Number of plants bearing marketable fruit.	Number marketable fruits.	Per cent of plants bearing marketable fruit.
ROUND WHITE.				
Deep	11	10	17	**90.9**
Shallow	15	10	14	**66.7**
CREOLE.				
Deep	13	7	9	**53.8**
Shallow	12	2	2	**16.7**
NEW YORK IMPROVED.				
Deep	14	5	5	**35.7**
Shallow	15	6	7	**46.7**

As will be observed Creole and Round White were much more productive when deep cultivation was practiced. New York Improved was very unproductive in both cases, but the plants given surface cultivation were slightly the more productive. The season was very dry and it is probable the chief advantage of the deep cultivation was in driving the feeding roots downward, the lose earth above forming a mulch.

Conclusion: Better effects appear to result from the deep cultivation of egg plants with the horse hoe than from shallow hand work.

3. *Is Frequent Cultivation Essential?* The writer has usually advised cultivating egg plants as often as once a week. And is often met by the farmer with the objection of "too much bother." An attempt was made the present season to determine if frequent

cultivation really is essential to success. Some plants were given the ordinary treatment of our garden, while a duplicate lot was given only sufficient attention to keep down the weeds. Unfortunately the varieties used—New York Improved and Round Purple—proved so unproductive that we are not justified in drawing final conclusions. In this instance, however, the plants given infrequent cultivation produced fully as many fruits as those under conditions usually regarded as more favorable. If it be proved that the egg plant may be grown with less care than commonly supposed, the fact, though of no importance to the gardener, may serve to remove some objections to the more common use of this vegetable.

4. *Effects of Root Pruning*: To ascertain whether a sudden check in the growth of the plants would result in increasing the number of fruits set, several of the main roots of a number of plants were severed August 19, after a small number of fruits had formed. Results were contradictory. Some varieties showed considerable increase in the number of fruits set, as compared with duplicate plants not pruned; others were apparently injured by the operation. The advantage of the operation from a practical point of view is questionable.

Summary.

1. The percentage of plants bearing marketable fruits, and the productiveness of individual plants, are increased by early setting in the field.
2. Better results are obtained from deep cultivation with the horse hoe than from shallow hand work.
3. Early dwarf varieties may be successfully grown with the ordinary care given tomato plants.
4. The advantage of root pruning egg plants is questionable.

V—Notes of Potatoes.

The principal work heretofore undertaken with potatoes has been in the line of a study of the influence of climate in causing variation of the plant—an experiment still in progress. During the past season a few experiments with different methods of culture were taken up incidentally.

1. *A comparison of the Trench System with Ordinary Culture*: A few years ago considerable interest was aroused by the accounts of wonderful yields of potatoes obtained by a system of culture

known as the *Rural New Yorker Trench System.* The system derives its name from the fact that it was first used at the trial grounds of the *Rural New Yorker*, and was advocated by the editor of that paper, Mr. E. S. Carman.

The system consists essentially in planting the tubers in trenches, five to seven inches deep and twelve to fifteen inches wide, the bottoms of which are well pulverized; covering to a depth of about two inches; then applying any desired amount of fertilizer in the trench; after which the trenches are filled so that after settling the surface shall be level.

Now it has been the practice of the writer for several years to plant in furrows, applying fertilizers broadcast on the surface of the ground, for there is little doubt that the old custom of "hilling" potatoes is worse than useless, it is positively injurious to the crop on dry soils It has seemed doubtful, in view of the fact that the roots of the potato extend in all directions, filling the whole space between the rows, whether placing the fertilizer in a trench only, could be as rational, or in practice as satisfactory, as the other method.

In the paper referred to and also in a book recently published, the statement is made that, "In every trial made the land laid out in trenches whether with or without fertilizer or manure has largely out-yielded that planted according to the old method of furrows or hills."*

In an issue of the *Rural New Yorker* of recent date is a detailed account of a comparison of the two methods as conducted on the grounds of the originator of the "Trench system." From this trial the following conclusions were drawn:

"There is a difference in the total yield per acre of only one-half bushel (.49) in favor of the trenches, but of the *marketable* potatoes there is a difference of over seventeen bushels per acre in favor of the trenches.

"The yield of small potatoes (unmarketable) of the furrows is 16.79 bushels per acre greater than that of the trenches."†

The work of this Station planned without the knowledge that similar work was being undertaken elsewhere, is detailed below:

---

* The New Potato Culture, page 35.

† Rural New Yorker, October 14, 1893, page 683.

On a piece of sandy loam, having a Southern aspect, alternate rows of the varieties named below were planted three and one-half feet apart—one being "trenched," the other planted in a furrow. The rows "trenched" were plowed about a foot wide and eight inches deep, after which the soil in the bottom of the furrow was loosened and pulverized, some earth being worked back into the furrow, the "seed" cut into two eyes was then planted one foot apart in the row. The pieces were covered to a depth of about two inches when a complete fertilizer at the rate of 1,000 pounds to the acre was scattered in the trenches, and the trenches were filled. The other rows were simply plowed, the seed pieces dropped and covered, when the same amount of fertilizer as before was scattered on the surface. As soon as the young shoots appeared above the surface, the smoothing harrow was used, and thorough culture was given until about the middle of July when the vines covered the ground sufficiently to keep the weeds down and serve as a mulch for themselves.

The comparative results are shown in the accompanying table:

TABLE XII.

TRENCH SYSTEM *vs.* ORDINARY CULTURE OF POTATOES.

Variety and System.	Weight of product—lbs.	Weight of marketable tubers—lbs.	Weight of small tubers—lbs.	Average number marketable tubers per hill.	Yield per acre of marketable tubers—bushels.	Yield per acre of small tubers—bushels.
Early Rose.						
No 1. Furrow	58.87	51.03	7.84	5.6	234.4	34.6
Trench	61.48	53.24	8.24	5.0	244.8	37.9
No. 2. Furrow	80.00	71.00	9.00	6.9	327.7	41.5
Trench	79.23	68.72	10.51	6.1	317.4	48.5
Crane's June.						
No. 1. Furrow	69.90	62.00	7.90	6.0	286.2	36.3
Trench	66.30	54.81	11.49	5.2	253.1	52.9
No. 2. Furrow	70.19	58.45	11.74	5.9	269.6	54.1
Trench	71.57	61.04	10.53	5.8	282.1	48.5
Hebron.						
Furrow	64.15	59.12	5.03	5.4	271.7	23.2
Trench	74.07	65.16	8.91	5.4	300.8	41.1

In every instance duplicate lots produced contradictory results. The first lot of Early Rose gave a greater yield from the trench—the difference being nearly ten bushels of marketable tubers per acre. The second lot reverses these figures so far as the marketable tubers are concerned, but the increased numbers of small tubers makes the total yield practically the same with the two methods of treatment. The first lot of Crane's June gave a difference of thirty-three bushels of marketable tubers per acre in favor of the furrow; while in the second lot the trench produced at the rate of twelve bushels per acre more than the other.

In each instance above mentioned, the number of marketable tubers per hill was slightly smaller in the trenches, and the weight of individual tubers was somewhat greater; on the other hand, with one exception the small tubers from the trenches excelled in weight and number those from the furrows.

Hebron from the trench was superior to the same variety from the furrow. The number of tubers per hill was the same, but the individual tubers from the trench were so much superior as to be equivalent to an excess of twenty-nine bushels per acre over the other.

It will be seen that these facts are in a measure opposed to conclusions concerning the system which have heretofore been published. We would not, however, condemn the method without further trial. It is but just to say, however, that certain parties quoted as obtaining specially marked results from the use of the "trench system" have discarded the method in their general practice.

Conclusion: It is questionable whether the results obtained will justify the extra labor involved in practicing the trench system of potato culture. In our trials the past season duplicate lots in every instance produced contradictory results.

VI—Notes of Spraying Experiments.

Spraying with some solution of copper for protection from the attack of the apple scab is coming to be looked upon as a necessity by many of the more progressive orchardists. During the past three seasons the writer has been engaged in solving some of the problems incident to this work. The results, so far as obtained, have been detailed in the annual reports of the experiment station.*

The principal work of the present season was a comparison of the effectiveness of different mixtures. The failure of certain trees,

* Report Maine Experiment Station, 1891, page 112; and 1892, page 92.

set apart for that purpose, prevented reaching more definite conclusions regarding the best time for spraying

The materials used in the work here mentioned, were as follows:

1st.—*Modified eau celeste.*—2 lbs. copper sulphate, 1 1-2 lbs. carbonate of soda, 1 1-2 pts ammonia and thirty-five gallons of water.

2nd.—*Bordeaux Mixture.*—6 lbs. copper sulphate (Blue Stone). 4 lbs. fresh lime dissolved separately, then mixed and diluted to 40 gallons.

3d.—*Bordeax Mixture and Paris Green.*—Same as No 2 with addition of Paris Green in the proportion of 1 lb to 150 gallons.

4th.—*Paris Green* —1 lb. Paris green in 250 gallons water.

The season was very dry and the trees were much freer from scab than in previous years. That there was marked benefit from the treatment is, however, shown in the accompanying photographs of fruit from contiguous trees and also in the table.

No. 1—Not Sprayed.

Free, 130. Badly Scabbed, 17. Slightly Scabbed, 392.

No. 2—Sprayed.

Free, 474. Badly Scabbed, 3. Slightly Scabbed, 114.

TABLE XIII.

RESULTS OF SPRAYING TO PREVENT APPLE SCAB.

Treatment.	Number fruit examined.	Free from scab.	Slightly scabbed.	Badly scabbed.	Per cent free.
Eau Celeste	651	480	156	15	**73.7**
	557	360	189	8	**64.6**
	459	368	73	18	**80.2**
Average per tree	**556**	**403**	**139**	**14**	**72.8**
Bordeaux Mixture	501	399	91	11	**79.6**
	591	474	114	3	**80.2**
Average per tree	**546**	**436**	**102**	**7**	**79.9**
Bordeuax Mixture and Paris Green	811	677	128	6	**83.5**
	639	509	126	4	**79.7**
	615	524	87	4	**85.2**
Average per tree	**755**	**570**	**114**	**5**	**82.8**
Checks, not Sprayed	566	214	337	15	**37.8**
	550	291	248	11	**52.9**
	539	130	392	17	**24.1**
Average per tree	**552**	**212**	**292**	**14**	**38.3**

Much of the fruit classed as "slightly scabbed" would grade as No. 1 fruit, but as is well known, the fungus grows rapidly after the fruits are packed ; hence our arbitrary line between fruit *absolutely free* from scab and that slightly affected is rigidly adhered to.

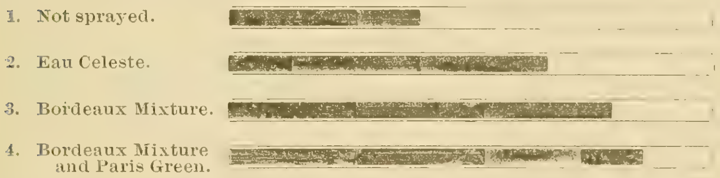
As shown by the table, the best results were obtained from the use of a combination of Bordeaux mixture and Paris green. This fact would indicate a possible fungicidal value for Paris green. That this value is slight, however, was shown by some trees sprayed with Paris green only. Our experiments have not been sufficiently extended to warrant definite conclusions on this point. The Paris green has, however, an important use in reducing the proportion of wormy fruits.

Eau Celeste, while less effectual than Bordeaux mixture in preventing scab, was found to injure the foliage unless used with caution. The fruit also, was made somewhat rusty—the epidermis apparently being injured by the ammonia.

The relative value of the different materials used may best be summarized as follows:

Checks, not sprayed.. .. .. 38.3 per cent free from scab.
Modified *Eau Celeste* .... 72.8 " " " "
Bordeaux mixture.... .. .. 79 9 " " " "
Bordeaux mixture and Paris green, 82 8 " " " "

These differences are graphically portrayed in the accompanying diagram, in which the shaded portion represents the per cent of fruit free from scab.



The concensus of opinion among experimenters at the present time places Bordeaux mixture at the head of the list of fungicides. A general summary of results obtained by the writer during the past three seasons is as follows, the figures representing the per cent. of fruit free from scab:

SPRAYING EXPERIMENTS, 1891-93.

	Checks not sprayed.	Ammonio-copper carbonate.	Modified eau celeste,	Bordeaux mixture.
1891	4.1	47.8	57.8	
1892	.93	6.1	30.1	
1893	38.3	-	72.8	79.9

A BRIEF RETROSPECT.

For the benefit of those who have not received previous reports, it may be well to give a brief resumé of the results obtained from three seasons' experiments.

We have seen that apple scab is caused by a parasitic fungus which attacks the leaves and young twigs as well as the fruit, and that the growth of the tree may be seriously checked. Spraying the trees with certain compounds of copper has been found an effective means of holding the disease in check,—the increase of salable fruit, as a result of spraying, often amounting to 50 per cent.

Indications point strongly to the value of spraying early in the season, before the blossoms open, and of repeating the application four or five times during the season.

The best results have been obtained from the use of Bordeaux mixture, prepared as follows: 6 pounds copper sulphate (Blue Stone); 4 pounds quick lime; 40 gallons water.

Dissolve the copper in a pail of hot water; slake the lime in another vessel; mix and dilute as above for use.

Farmers are advised to club together in the purchase of apparatus and chemicals, thus reducing expense.

Necessary chemicals may be obtained in large quantities of: Weeks & Potter Company, Boston; Eimer & Amend, 205 Third Avenue, New York; W. S. Powell & Company, Baltimore, Md. Most of the materials may be purchased in small amounts at the local drug store.

Force pumps and other apparatus for spraying may be obtained of any of the leading manufacturers, as: Field Force Pump Company, Lockport, N. Y.; Gould's Manufacturing Company, Seneca Falls, N. Y.; W. & B. Douglass, Middletown, Conn.; The Deming Company, Salem, O.

The most satisfactory nozzle we have used is the "McGowen," manufactured by John J. McGowen, Ithaca, N. Y. Our second choice is the "Climax," manufactured by the Nixon Nozzle and Machine Company, Dayton, O.

For spraying currant bushes, or for general garden use, the "Knapsack Sprayer" made by the Gould's Manufacturing Company, Seneca Falls, N. Y., has been found very satisfactory. Similar machines may be obtained from the other sources mentioned above.

VII—Catalogue of Maine Fruits.

One of the most important lines of work receiving attention from this division is that of the systematic effort to improve the character of some of our native fruits, and to select from the ever increasing list of new varieties, those best suited for the different sections of the state. This work is still in its infancy and no results can yet be reported. It is thought best, however, to publish a catalogue of the fruits grown in the state at the present time with an indication of their approximate value in different sections.

The descriptions of fruits are mostly taken from the fruit list of the American Pomological Society, and the values accorded are given only after carefully considering the recommendations of leading fruit growers in different parts of the State. Information concerning many varieties, especially in the northern sections is very meagre. It is hoped before a revision of the list is made,—as will necessarily follow in course of two or three years,—more valuable data may be available.

Of the newer apples named in the catalogue, Dudley's Winter, a seedling of Oldenburg originated by J. W. Dudley of Castle Hill, Aroostook county, is one of the most valuable "iron clad" varieties. This variety is being disseminated by a New York firm as "North Star"—an unfortunate circumstance as there is another variety bearing that name by right of priority.

Hayford Sweet is another valuable iron-clad variety originating with C. Hayford, Maysville, Aroostook county. It is in itself a valuable fruit and succeeds where Talman Sweet fails.

Rolfe and Russell are also deserving of special mention. Mother, as a fruit for home use, is not as widely known as it should be; but it is not a profitable market variety.

Of the newer pears, Admiral Farragut, Eastern Belle, Fulton, Indian Queen and Nickerson are promising, hardy varieties. These are not of the highest quality but they are hardy and productive—important considerations especially for the northern and central portions of the state.

Flemish Beauty, formerly grown in many sections of the state, has been almost universally discarded because of the prevalence of pear scab (*Fusicladium pyrinum*). It is hoped that by the aid of the Bordeaux mixture we may yet retain this valuable variety.

Moore Arctic plum, (a native of Ashland, Aroostook county), because of its productiveness and extreme hardiness, is planted more extensively than any other variety in northern Maine. It is not, however, of the best quality. The Japanese varieties, Abundance and Burbank, are being tried to a limited extent in the southern portions of the state, but they can succeed only in the southern counties. McLaughlin, originated at Bangor more than forty years ago, is still one of our most valuable dessert plums. It is, however, rather tender for market purposes.

DeSoto, Forest Garden, Wolf, and some other varieties of the native "horse plum" or "pomegranate" (*Prunus Americana*), promise to be of some importance for the colder portions of the state.

Small fruits, though not largely grown for market, do well in all of the central and southern counties. The cool moist climate is specially adapted to the wants of the currant and gooseberry. Even as far north as Houlton, Aroostook county, the gooseberry is a profitable market crop; and if, as now seems probable, the English varieties will succeed in this climate, a very profitable industry is opened along this line.

The widely varying conditions existing in different parts of the state render a general statement as to the value of any given variety only approximately correct. Varieties which may be of merit in the southern portions of the state are not sufficiently hardy for the middle and northern counties. On the other hand, some sorts considered specially valuable in Aroostook county are unknown in York In the accompanying catalogue we have assigned separate columns for the value of each variety in the northern and the southern parts of the state. The first column, marked "North," includes Aroostook, Piscataquis, and the northern parts of Somerset, Penobscot and Washington counties. The column marked "South," includes Oxford, Kennebec, Waldo, and all of the southern counties.

The value of any given variety is indicated thus: Two stars (* *) indicate a variety of special merit, one to be recommended for general culture. One star (*) shows that the variety is worthy of cultivation, though not superior. A dagger (†) indicates a new and promising variety, or an old variety not fully tested in this region. A dash (—) shows that the variety has been tried and found wanting.

The abbreviations used in describing the size*, form, color, etc., of the various classes of fruits are fully explained at the head of each list. Take for example the Alexander apple. We see that this is a large striped apple of roundish-conical form and moderately good quality, useful for cooking and market early in autumn.

---

*A few varieties of apples usually described as large, are as grown in this state, of only medium size—e. g. Baldwin, Golden Sweet, Hubbardston, Porter.

9

APPLES.

ABBREVIATIONS USED.—*Size*,—l, large; m, medium; s, small. *Form*,—r c, roundish-conical; r ob, roundish-oblate; r, roundish. *Color*,—y r, yellow and red; r s, red striped; g y, greenish yellow; rus, russeted; y rus, yellow and russet. *Quality*,—g, good; v g, very good; b, best. *Use*,—F, family use; K M, kitchen and market; F M, family and market. *Season*,—S, summer; E A, early autumn; L A, late autumn; W, winter. *Origin*,—usual abbreviations for names of countries.

Number.	Names.	Description.							Value.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Alexander	l	r c	r s	g	K M	E A	Rus.	*	*
2	August	....	......	.....	...	.....	.....	......	†	....
3	Autumn	....	......	.....	...	.....	.....	......	†	....
4	Bailey Sweet	l	r c	r s	v g	F M	L A	Am.	..	*
5	Baldwin	l	r c	r g	v g	F M	W	Am.	—	**
6	Beauty of Kent	l	r c	r s	g	K M	L A	Eng.	....	*
7	Ben Davis	l	r c	y r	g	K M	W	Am.	—	**
8	Benoni	m	r ob	y r	v g	F M	S	Am.	....	*
9	Black Oxford	....	.....	......	....	.....	.....	.....	—	—
10	Bloom	....	......	......	....	.....	.....	......	†	....
11	Blue Pearmain	l	r c	r	g	M	W	......	—	*
12	Bullock, *American Golden Russett*	s	r c	y rus	b	F M	W	Am.	...	*
13	Canada Baldwin	m	ob	r	v g	.....	W	Can.	....	*
14	Chenango (Strawberry), *Sherwood Favorite*	m	ob c	g r	v g	F M	E A	Am.	....	*
15	Cole Quince	l	r ob	g y	v g	F M	W	Am.	....	*
16	Colton	....	.....	......	....	.....	.....	......	†	...
17	Cooper Market	m	r c	y r	g	M	W	Am.	...	*
18	Danvers Sweet, *Danvers Winter*	m	r ob	g y	v g	F M	W	Am.	....	*
19	Dudley Winter	m	r ob	y r	g	F M	W	Am.	**	*
20	Dyer, *Pomme Royal*	m	r	g y	v g	F	E A	F.	....	*
21	Early Harvest	m	r ob	g y	v g	F M	S	Am.	*	*
22	Early Scarlet	....	.....	......	...	.....	.....	......	†	....
23	Early Strawberry *Red Juneating*	s	r	r s	v g	F	S	Am.	....	*
24	English Russett, *Poughkeepsie Russett*	m	r c	y rus	v g	F M	W	Eng.	....	—
25	Esopus Spitzenburg	l	ob	y r	b	F M	W	Am.	....	*
26	Fallawater	l	r c	g y	g	M	W	Am.	....	*
27	Fall Harvey	l	r ob	g y	g	M	L A	Am.	....	*
28	Fall Jenneting	l	fl	g y	g	M	E A	Am.	†	*
29	Fall Pippin	l	r ob	g y	v g	F M	L A	Am.	....	*
30	Fall Queen, *Haas*, *Gros Pommier*	m	ob c	y r	g	F M	A	Am.	—	—
31	Fameus, *Snow Apple*	m	r ob	r s	v g	F M	W	F.	**	**
32	Foundling	m	r ob	y r	g	F	A	Am.	†	*
33	Garden Royal	m	r c	y r	b	F	S	Am.	—	*
34	Garden Sweet	m	r ob	y r	v g	K M	A	Am.	...	*
35	Gideon	...	......	....	....	.....	.....	......	—	—
36	Golden Russet of Western N. Y.	m	r ob	y rus	v g	F M	W	......	....	*
37	Golden Sweet	l	r	g y	v g	F M	S	Am.	....	*
38	Granite (Beauty)	l	r ob	y r	g	F M	W	Am.	....	**
39	Gravenstein	l	r ob	y r	v g	F M	L A	Ger.	—	**
40	Grimes Golden	m	r ob	g y	v g	F	W	Am.	—	*
41	Hayford Sweet	s	r c	y r	g	F M	W	Am.	**	†
42	High Top Sweet, *Sweet June*	s	r	g y	v g	F M	S	Am.	—	*
43	Hubbardston, *Hubbardston Nonesuch*	l	r c	y r	v g	F M	W	Am.	....	**

7, valuable for distant market; worthless for home use. 12, 24 and 36 are often confounded; 36 is the variety most commonly met. 26, handsome, but coarse and of inferior quality in this climate. 39, one of the most valuable autumn varieties.

Apples—Continued.

Number.	NAMES.	DESCRIPTION. Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	VALUE. North.	South.
44	Hunt Russett..	m	r ob	y rus	v g	F M	W	Am.	....	*
45	Hurlbut............	m	r ob	y r	g	F M	L A	Am.	....	*
46	Jewett Red, *Jewett's Fine Red, Nodhead*	m	r ob	r	g	F M	W	Am.	....	**
47	Late Strawberry, *Autumn Strawberry*	m	r	y r	v g	F M	L A	Am.	....	*
48	Longfield	m	r ob	y r	g	K M	L A	Rus.	†	*
49	Magog Red Streak..................	....	....	......	....	.....	.....	......	†	....
50	Maiden Blush	m	r	g y	g	K M	E A	Am.	....	*
51	Mann	m	r ob	y r	v g	F M	W	Am.	—	*
52	McIntosh	m	r ob	y r	v g	F M	W	Am.	....	*
53	Mexico	m	r ob	r s	v g	F M	A	Am.	....	†
54	Milden or Milding	l	fl	y r	v g	F M	E W	Am.	....	*
55	Minister	l	ob	r s	g	K M	L A	Am.	....	*
56	Monroe Sweet	....	......	... ..	....	.....	.....	.....	†	....
57	Mother	m	r c	y r	b	F M	W	Am.	....	**
58	Munson Sweet, *Orange Sweet*	m	fl	y g	g	K M	L A	Am.	....	*
59	New Brunswick Greening......	....	......	......	....	.....	.....	......	†	....
60	Northern Spy	l	r c	y r	b	F M	W	Am.	—	**
61	Oldenburg, *Duchess of Oldenburg*......	m	r ob	y r	g	M	S	Rus.	**	**
62	Peabody Greening	...	.. ..	......	....	.....	.....	......	—	....
63	Peach (of Montreal)....	m	r c	y s	v g	F M	A	F.	*	....
64	Peck Pleasant	m	r	g y	v g	F M	W	Am.	....	*
65	Pewaukee................................	l	fl	r s	g	F M	W	Am.	*	*
66	Porter	l	ob	g y	b	F M	A	Am.	—	**
67	President	l	r ob	y	g	F	A	Am.	....	*
68	Primate	m	r c	g y	b	F	E A	Am.	...	*
69	Prolific Sweeting	....	.....	......	....	.....	.....	......	†	....
70	Pumpkin Sweet, *Lyman's Pumpkin Sweet, Pound Sweet*..................	l	r ob l	y	g	K M	E W	Am.	....	*
71	Ramsdell Sweet	m	ob	y r	g	K M	L A	.....	....	**
72	Red Astrachan	l	r	y r	g	K M	S	F.	*	**
73	Red Beitigheimer	....	......	... ..	....	.....	.....	......	†	†
74	Red Canada, *Old Nonesuch, Richfield Nonesuch, Steele's Red Winter*........	m	r ob	y r	b	F M	W	......	†	*
75	Rhode Island Greening................	l	r ob	g y	v g	F M	W	Am.	—	**
76	Ribston, *Ribston Pippin*...............	m	r	y r	v g	F M	W	Eng.	....	*
77	Rolfe, *Macomber*	m	r c	y r	v g	F M	W	Am.	—	**
78	Rome Beauty............................	l	r	y r	g	M	L A	Am.	....	†
79	Roxbury Russett	m	r ob	y rus	v g	F M	W	Am.	....	*
80	Russell	l	ob	y	v g	F	E A	Am.	†	†
81	Saint Johnsbury Sweet................	....	......	......	....	.....	.....	......	†	....
82	Saint Lawrence.....	l	fl	y r	v g	M	A	......	†	*
83	Sarah....................................	l	fl	r s	v g	F M	E A	Am.	.. .	†
84	Scott's Winter	....	......	......	....	.....	.....	......	†	....
85	Somerset (of Maine)	m	fl	r s	v g	F	S	Am.	....	*
86	Sops of Wine, *Hominy*................	m	r	y r	g	K M	E A	Eng.	—	*
87	Stark......	l	r c	y r	g	F	W	Am.	...	*
88	Starkey............	m	r ob	y r	v g	F M	E W	Am.	....	*
89	Summer Pearmain, *American Summer*................................	m	ob	y r	b	F	S	Am.	....	*
90	Summer Paradise	l	r	g y	v g	F	E A	Am.	....	*
91	Sutton, *Sutton Beauty*	m	r ob	r s	v g	F M	E W	Am.	....	†
92	Swaar....................................	l	r ob	g y	b	F M	W	Am.	...	†
93	Sweet Bough, *Large Yellow Bough* ...	l	ob	g y	v g	F M	S	Am.	....	*
94	Sweet Janet	....	......	......	....	.....	.....	......	....	†

Apples—Concluded.

Number.	NAMES.	DESCRIPTION. Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	VALUE. North.	South.
95	Tetofsky	m	fl c	y r	g	K	S	Rus.	**	*
96	Talman Sweet	m	r	g y	v g	K M	W	Am.	**	—
97	Tompkins King, *King of Tompkins County*	l	r	y r	v g	F M	W	Am.	—	*
98	Twenty Ounce, *Cayuga Red Streak*	l	r	r s	v g	F M	L A	Am.	....	*
99	Wagener	m	r ob	y r	b	F	W	Am.	....	*
100	Walbridge	...	......	......	....	.....	.....	......	†	....
101	Washington (Strawberry)	l	r c	y r	v g	F M	E A	Am.	....	*
102	Wealthy	m	r ob	r	v g	F M	W	Am.	**	*
103	Westfield (Seek-no-further)	l	r c	y r	b	F M	W	Am.	....	*
104	Williams (Favorite)	m	r c	g y	g	M	S	Am.	—	**
105	Wine, *Hay's Wine, Pennsylvania Red Streak*	l	r	y r	v g	F M	W	Am.	...	*
106	Winesap	m	r	y r	v g	F M	W	Am.	....	*
107	Winthrop Greening	l	ob	g y	g	K M	A	Am.	....	*
108	Wolf River	l	r ob	r	g	F M	W	Am.	....	†
109	Yellow Bellefleur	l	ob	g y	v g	F M	W	Am.	—	**
110	Yellow Transparent	m	r ob	y	g	.....	E S	Rus.	**	*

APPLES—Crabs.

Number.	NAMES.	DESCRIPTION. Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	VALUE. North.	South.
1	Hayden	....	.. ...	....	....	.....	.....	......	†	...
2	Hyslop	l	r	r	g	F M	A	Am.	*	*
3	Lady Elgin	l	r ob	y r	v g	F M	L A	Am.	**	....
4	Marengo	l	r fl	y r	g	F M	W	Am.	....	†
5	Montreal Beauty	l	r ob	y r	g	F M	A	Am.	....	*
6	Red Siberian	m	r	r	g	F M	A	F.	....	*
7	Transcendent	l	r ob	y r	g	F M	A	Am.	*	**
8	Van Wyck	....	......	....	....	.....	.....	......	....	*
9	Yellow Siberian	m	r	y	g	F M	A	F.	....	*

BLACKBERRIES.

ABBREVIATIONS—*Size*,—l, large; m, medium; s, small. *Form*,—ob c, oblong conic; r c, roundish conical or oval; ob ov, oblong oval. *Color*,—b, black. *Quality*, —g, good; v g, very good; b, best. *Use*,— F M, family and market; M, market. *Season*,—M, medium; E, early; L, late. *Origin*,—Am, American; F, foreign.

Number.	NAMES.	DESCRIPTION.							VALUE.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Agawam..	...	......	....	....	......	......	......	*	**
2	Ancient Briton......................	l	ob ov	b	v g	F M	M	Am.	....	†
3	Early Harvest	m	ov	b	g	F M	V E	Am.	...	—
4	Erie	l	ob ov	b	g	F M	M	Am.	....	†
5	Kittatinny	l	r c	b	b	F M	M	Am.	....	—
6	Lawton, *New Rochelle*..................	l	ov	b	g	M	L	Am.	....	—
7	Minnewaski.....................	l	ov	b	g	M	M	Am.	....	†
8	Snyder	m	r ov	b	v g	F M	E	Am.	†	**
9	Stone (Hardy)	l	ob	b	g	F	.....	Am.	....	†
10	Taylor, *Taylor's Prolific*	l	......	b	g	F M	......	Am.	....	†
11	Tree, *Child's Ever-bearing Tree*	....	......	....	....	......	......	......	....	—
12	Wauchusett	m	ob ov	b	v g	F M	M	Am.	....	—
13	Wilson (Early).........	l	ob ov	b	v g	M	E	Am.	....	*
14	Wilson Junior.	l	ob ov	b	v g	M	E	Am.	....	†

DEWBERRIES.

ABBREVIATIONS.—Same as for blackberries.

Number.	NAMES.	DESCRIPTION.							VALUE.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Lucretia	l	ob ov	b	v g	F M	V E	Am.	....	†
2	Windom	....	......	....	....	......	......	......	†	†

CHERRIES.

ABBREVIATIONS.—*Size*,—l, large; m, medium; s, small. *Form*,—ob h, obtuse heart shape; r ob h, roundish obtuse heart shape; r h, roundish heart shape; r, roundish or round. *Color*,—l r, lively bright red; d r, dark red, almost black; a m, amber mottled with red; y r, yellow ground, shaded and marbled with red. *Use*,—F, family, for dessert: F M, family or market; K M, cooking or market; M, market. *Season*,—E, early; M, medium; L, late. *Origin*,—F, foreign; Am, American.

Number.	NAMES.	DESCRIPTION.						VALUE.	
		Size.	Form.	Color.	Use.	Season.	Origin.	North.	South.
	HEARTS AND BIGARREAUS.								
1	Bigarreau, *Graffion, Yellow Spanish*	l	ob h	y r	F M	M	F	....	†
2	Black Heart	l	r h	d r	F M	M	F	...	*
3	Black Tartarian	l	r h	d r	F M	M	F	....	*
4	Coe's Transparent	m	r	a m	F	M	Am	....	*
5	Downer's Late	m	r h	y r	F M	L	Am	....	*
6	Early Purple, *Early Purple Guigne*	m	r h	d r	F M	E	F	...	*
7	Elton	l	r h	y r	F M	M	F	....	*
8	Governor Wood	l	r h	y r	F M	M	Am	..	*
9	Napoleon	l	r ob h	y r	F M	M	F	....	*
10	Windsor	l	r h	d r	M	L	Am	....	†
	DUKES AND MORELLOS.								
41	Choisy	m	r	a m	F	M	F	....	*
12	Early Richmond.	s	r	l r	K M	E	F	....	*
13	Hortense	l	r	l r	F M	L	F	....	†
14	Late Duke	l	ob h	d r	K M	L	......	...	*
15	Louis Phillippe	l	r	d r	K M	L	F	....	*
16	Magnifique	l	r h	l r	K M	L	F	....	*
17	May Duke	l	r ob h	d r	K M	E	F	....	*
18	Montmorency, Laıge	l	r	d r	K M	M	F	....	†
19	Montmorency, Ordinaire	....	... .	....	......	....	......	....	†
20	Morello, *English Morello, Large Morello*	l	r h	d r	K M	L	F	....	*

CURRANTS.

ABBREVIATIONS.—*Size*,—l, large; m, medium; s, small. *Form*,—with reference to form of bunch,—l, long; v l, very long; s, short; m, medium. *Color*,—r, red; b, black; w, white. *Quality*,—a, acid; m a, moderately acid; v a, very acid. *Use*,—K M, kitchen and market; F M, family and market; M, market. *Season*,—E, early; M, medium; L, late. *Origin*,—Am, American; F, foreign.

Number.	NAMES.	DESCRIPTION.							VALUE.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Black Naples	l	s	b	m a	K M	M	F	....	*
2	Cherry	l	s	r	v a	M	M	F	*	*
3	Fay, *Fay's Prolific*	l	l	r	m a	F M	M	Am	**	**
4	Lee, *Lee's Prolific*	l	l	b	m a	K M	M	F	....	*
5	Moore Ruby	m	....	......	....	......	.....	......	....	†
6	Prince Albert	l	l	r	m a	M	L	F	....	*
7	Red Dutch	m	m	r	m a	F M	E	F	*	*
8	Versaillaise, *La Versaillaise*	l	s	r	a	M	M	F	....	**
9	Victoria, *Raby Castle*	l	v l	r	a	F M	L	F	....	*
10	White Grape	m	l	w	m a	F M	E	F	**	**

GOOSEBERRIES.

ABBREVIATIONS.—*Size*,—l, large; m, medium; s, small. *Form*,—r, round; o, oval; r o, roundish oval. *Color*,—r, reddish when fully ripe: g, greenish yellow when fully ripe. *Quality*,—g, good; v g, very good; b, best. *Use*,—K, kitchen; M, market. *Season*,—E, early; M, medium; M L, medium-late. *Origin*,—Am, American; F, foreign.

Number.	NAMES.	DESCRIPTION.							VALUE.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Downing	m	r o	g	v g	K	M L	Am	*	**
2	Houghton	s	r o	r	g	K M	E	Am	**	**
3	Industry	l	r o	r	v g	K	M	F	....	†
4	Smith, *Smith's Improved*	l	o	g	v g	K M	M	Am	*	*
5	Whitesmith	l	o	g	v g	K M	M	F	....	†

GRAPES.

ABBREVIATIONS.—*Size*,—with reference to the berry,—l, large; m, medium; s, small. *Form*,—with reference to bunch and berry,—s r, short bunch, round berry; l r, large and round; m r o, medium bunch, roundish-oval berry; m r, medium bunch, round berry. *Color*,—b, black, or nearly so when fully ripe; r, reddish, or coppery-brownish red; g, greenish-white or yellowish. *Quality*,—g, good; v g, very good; b, best. *Use*,—T, table; M, market; W, wine. *Season*,—E, early; M, medium; L, late. *Origin*,—the species to which each variety belongs; Lab, *Vitis Labrusca; Æst*, *æstivals;* Rip, *Riparia*; Vulp, *Vulpina*. An X after one of the species denotes a cross with a variety of some other species. Hyb, hybrid between a foreign variety and one of the native species.

Number.	NAMES.	DESCRIPTION.							VALUE.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Agawam, *Rogers' No. 15*	l	s r o	r	g	T M	M	Hyb	....	*
2	Brighton	l	r	d r	v g	T	E	Hyb	....	†
3	Concord	l	l r	b	g	T M W	M	Lab	....	*
4	Delaware	s	s r	r	b	T M W	M	? X	....	*
5	Diana	m	s r o	r	v g	T M	L	Lab	....	—
6	Green Mountain	....	......	....	....	....	......	......	...	†
7	Hartford, *Hartford Prolific*	l	m r o	b	g	M	E	Lab	....	*
8	Iona	m	m r o	r	b	T M W	L	Lab	....	—
9	Moore's Early	l	r	b	g	T M	V E	Lab	....	**
10	Niagara	l	r	w	g	T M	M	Lab	....	†
11	Salem, *Rogers' No. 52*	l	r	b	g	M	M	Hyb	....	*
12	Wilder, *Rogers' No. 4*	l	l r	b	v g	T M	M	Hyb	....	*
13	Worden	l	r	b	g	T M	E	Lab	....	*
14	Wyoming	....	.....	....	....	....	......	......	....	†

QUINCES.

ABBREVIATIONS.—*Size*,—l, large; m, medium; s, small; v, very. *Form*,—o, oblate; ob, obtuse: p, pyriform; r, roundish. *Color*,—g, greenish; y, yellowish. *Quality*,—h, half tender; t, tender. *Use*,—K, kitchen; M, market. *Season*,—E, early; L, late. *Origin*,—Am, American; F, foreign.

Number.	NAMES.	DESCRIPTION.							VALUE.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Alaskan	....	......	....	...	....	......	......	....	†
2	Angers	v l	r ob p	y	t	M K	E L	F	....	*
3	Apple or Orange	l	r	y	h t	M K	E L	......	....	*

PEARS.

ABBREVIATIONS.—*Size*,—s, small; l, large; m, medium. *Form*,—p, pyriform; r o p, roundish obtuse pyriform: r a p, roundish acute pyriform; ob p, obtuse pyriform; ob o p, oblong obtuse pyriform; r, roundish; r ob, roundish obtuse. *Color*,—y g, yellow or yellowish green with a red or russet red cheek; y r, yellow and russet; y, when mostly yellow or yellowish. *Quality*,—g, good; v g, very good; b, best. *Use*,—F, valuable family dessert: K M, kitchen and market; F M, family and market. *Season*,—S, summer; L S, late summer; A, autumn; E A, early autumn; W, winter. *Origin*,—Eng, English; Am, American; F, Flemish; B, Belgium; H, Holland.

Number.	NAMES.	DESCRIPTION.							VALUE.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Admiral Farragut	l	r a p	y g	g	K M	A	Am	....	†
2	Angoulême, *Duchesse d' Angouleme*	l	ob o p	y	v g	F M	A	F	....	**
3	Anjou. *Beurre d' Anjou*	l	ob p	y g	v g	F M	L A	F	....	**
4	Bartlett	l	ob o p	y	v g	F M	L S	Eng	....	**
5	Bosc, *Beurre Bosc*	l	p	y r	b	F M	L A	B	....	*
6	Boussock, *Doyenne Boussock*	l	r o p	y r	v g	F M	E A	B	..	*
7	Buffum	m	r o p	y g	g	M	E A	Am	....	*
8	Clairgeau, *Beurre Clairgeau*	l	p	y r	g	M	L A	F	....	*
9	Clapp Favorite	l	ob o p	y g	v g	F M	S	Am	....	**
10	Diel, *Beurre Diel*	l	r ob p	y r	v g	F M	L A	B	....	*
11	Easter Beurre	l	r ob p	y r	v g	F	W	B	....	†
12	Eastern Belle	m	ob p	y r	v g	F	E A	Am	....	*
13	Flemish Beauty	l	r ob p	y g	v g	F M	E A	B	....	—
14	Fulton	s	r ob	y r	v g	F	A	Am	....	*
15	Giffard	m	p	y g	v g	F M	S	F	...	*
16	Goodale	l	ob p	y g	v g	F M	A	Am	....	†
17	Hardy, *Beurre Hardy*	l	ob p	y g	v g	F M	E A	......	....	*
18	Howell	l	r p	y g	v g	F M	E A	Am	....	*
19	Indian Queen	l	p	y g	g	K M	A	Am	....	†
20	Josephine of Malines	m	r ob p	y r	v g	F M	W	F	...	*
21	Lawrence	m	r o p	y r	v g	F M	W	Am	....	**
22	Louise Bonne of Jersey	l	ob p	y g	v g	F M	E A	F	....	**
23	Lucrative, *Belle Lucrative*	m	ob r	y g	b	F	E A	Fl	....	**
24	McLaughlin	l	ob p	y g	v g	F M	W	Am	....	*
25	Nickerson	l	ob p	y g	g	F M	A	Am	*	†
26	Onondaga, *Swan's Orange*	l	ob p	y g	v g	F M	L A	Am	....	*
27	Rostiezer	s	p	y g	b	F	S	.... .	....	*
28	Seckel	s	r	y g	b	F M	A	Am	....	*
29	Sheldon	m	r	y g	v g	F M	A	Am	....	**
30	Souvenir du Congres	l	p y r	y g	v g	F M	S	F	....	†
31	Summer Doyenne, *Doyenne d' Ete*	s	r o p	y g	v g	F	S	B	....	*
32	Superfin, *Beurre Superfin*	m	r p	y r	v g	F	A	F	....	*
33	Tyson	m	r a p	y g	b	F	S	Am	....	*
34	Vicar, *Vicar of Winkfield, Le Cure*	l	p	y	g	K M	W	F	....	*
35	Winter Nelis	m	ob p	y r	b	F M	W	B	..	*

PLUMS.

ABBREVIATIONS.—*Size*,—l, large; m, medium; s, small. *Form*,—o, oval; ob, obovate; r, roundish. *Color*,—g, greenish; p, purplish; r, reddish; y, yellow. *Quality*,—g, good; v g, very good; b, best. *Use*,—F, family; M, market. *Season*,—E, early; L, late; M, medium. *Origin*,—Am, American; F, foreign.

Number.	NAMES.	DESCRIPTION.							VALUE.	
		Size.	Form.	Color.	Quality	Use.	Season.	Origin.	North.	South.
1	Abundance	m	r o	p	g	F M	M	Jap	....	†
2	Bavay, *Bavay's Green Gage*	l	r	g y	b	F	L	F	...	**
3	Bleeker Gage	m	r o	y	v g	F M	M	Am	...	*
4	Burbank	m	r	p	g	F M	M	Jap	....	†
5	Bradshaw	l	o ob	r p	g	M	M	Am	....	*
6	Coe Golden Drop	l	o	y r	v g	F M	L	F	....	*
7	Columbia	l	r	p	g	M	M	Am	....	*
8	Damson	s	o	p	g	M	L	Am	*	*
9	De Soto	m	r o	y r	v g	F M	M	Am	†	†
10	Duane Purple	l	o	r p	g	F M	E	Am	....	*
11	Forest Garden	m	r	r	v g	F M	E	Am	†	†
12	Green Gage	s	r	g y	b	F	M	F	*	*
13	Huling, *Huling Superb*	l	r o	g y	g	F M	M	Am	....	*
14	Imperial Gage	l	o	g y	b	F M	M	Am	.	**
15	Italian Prune, *Fellemburg*	m	o	p	g	F M	M	F	...	*
16	Jefferson	l	o	y r	b	F M	M	Am	...	*
17	Lombard	m	r o	r p	g	M	M	Am	—	*
18	McLaughlin	l	r	y r	b	F M	M	Am	....	**
19	Moore Arctic	m	r o	p	g	F M	M	Am	**	*
20	Penobscot	....	....	....	....	.. ...	....	Am	....	*
21	Pond, *Fonthill*	l	o	y r	g	M	M	F	....	*
22	Purple Gage	m	r	p	v g	F M	M	.....	....	*
23	Quackenboss	l	r	p	g	M	M	Am	....	*
24	Rollingstone	....	....	....	....	... .	....	Am	†	†
25	Shropshire Damson	s	o	p	g	F M	L	Eng	....	*
26	Smith Orleans	l	o	r p	v g	F M	M	Am	*	*
27	Washington	l	r o	g y	v g	F M	M	Am	....	*
28	Wolf	m	o	y r	g	F M	M	Am	†	†
29	Yellow Egg, *White Magnum Bonum*	l	o	y	g	F M	M	......	....	*

1 and 4 Japanese varieties which can succeed only in the southern parts of the State. 9, 11, 24 and 28, improved varieties of *Prunus Americana*, the native "horse plum" or "pomegranate." 19, the most popular variety for Aroostook county.

RASPBERRIES.

ABBREVIATIONS.—*Size*,—l, large; m, medium; s, small; v, very. *Form*,—c, conical; o, obtuse; r, roundish. *Color*,—b, black; p, purplish; r, reddish; y, yellow. *Quality*,—b, best; g, good; v, very. *Use*,—M, market; F, family. *Season*,—E, early; L, late: M, medium. *Origin*,—Am, American; F, foreign.

Number.	Names.	Description. Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	Value. North.	South.
	SUB-SECTION I.—RUBUS IDÆUS.									
1	Clarke	m	r	r	g	F M	E	Am	....	*
2	Herstine	l	ob c	r	v g	F M	M	Am	....	†
3	Knevett	l	ob c	r	b	F	M	F	...	—
4	Orange, *Brinckle's*	l	c	y	b	F	M	Am	....	—
	SUB-SECTION II.—R. NEGLECTUS.									
1	Philadelphia	m	r	p	g	M	M	Am	....	—
2	Shaffer	v l	r	p	g	F M	M	Am	....	*
	SUB-SECTION III.—R. OCCIDENTALIS.									
1	Gregg	v l	r	b	g	F M	M	Am	....	**
2	Hilborn	....	......	....	....	......	.....	......	....	†
3	MacCormick, *Mammoth Cluster*	m	ob c	b	v g	F M	L	Am	....	*
4	Nemeha	....	......	....	....	......	.....	......	....	†
5	Souhegan	m	r	b	g	F	E	Am	...	*
6	Tyler	m	r	b	v g	F M	E	Am	....	*
	SUB-SECTION IV.—R. STRIGOSUS.									
1	Cuthbert, *Queen of the Market*	l	r o	r	g	F M	M	Am	....	**
2	Golden Queen	l	r c	y	v g	F M	M	Am	....	**
3	Hansell	m	r c	r	v g	F M	V E	Am	....	†
4	Marlboro	l	r c	r	g	F M	M	Am	....	*
5	Turner	m	r	r	g	F M	E	Am	....	*

STRAWBERRIES.

ABBREVIATIONS.—*Size*, l, large; s, small; m, medium. *Sex*,—B, bisexual; P, pistillate; P B, nearly pistillate. *Color*,—d c, deep crimson; d s, deep scarlet; b s, bright scarlet; w t, whitish tinted with red; l c, light crimson. *Form*,—r c, roundish conical; o c, obtuse conical or coxcomb form; c, conical; r, roundish; r o c, roundish obtuse conical. *Flesh*,—s, soft; f, firm; m, medium. *Season*,—E, early; M, medium; L, late; E L, early to late. *Origin*,—Am, American; F, foreign.

Number.	Names.	Description.							Value.	
		Size.	Sex.	Color.	Form.	Flesh.	Season.	Origin.	North.	South.
1	Beeder Wood	....	....	....	....	....	....	....	....	†
2	Beverly	....	....	....	....	....	....	....	....	†
3	Boynton	....	....	....	....	....	....	....	....	†
4	Bubach No. 5	....	P	....	....	....	....	Am	*	*
5	Burt	....	....	....	....	....	....	....	....	†
6	Charles Downing	l	B	d s	c	f	M	Am	*	*
7	Col. Cheney	l	P	b s	o c	f	M	Am	...	*
8	Crawford	l	B	b c	o c	m	M	Ohio	...	†
9	Crescent	l	P	b s	r c	m	M	Am	**	**
10	Cumberland, *Cumberland Triumph*	v l	B	b s	r c	s	M	Am	....	*
11	Gandy	....	B	b r	c	f	....	Am	....	†
12	Haverland	l	P	r s c	o c	m	M	Am	....	**
13	Jessie	v l	B	b s	r c	m	M	Am	....	*
14	Manchester	l	P	s	o c	f	M	Am	....	*
15	May King	....	....	....	....	....	....	....	....	*
16	Michel's Early	....	..	....	....	....	....	....	....	†
17	Miner, *Miner's Great Prolific*	v l	B	c	r c	m	M	Am	....	*
18	Monmouth	....	....	....	....	....	....	....	...	†
19	Mrs. Cleveland	....	....	....	....	....	....	....	....	†
20	Parker Earle	l	B	b r	l c	f	M	Tex	....	†
21	Pearl	m	B	d r	o c	f	M	Am	....	†
22	Sharpless, *Ontario*	v l	B	b r	o c	f	M	Am	....	*
23	Triomphe de Gand	l	B	l c	o c	f	M	F	....	*
24	Warfield	m	P	d r	c	f	M	Ill	....	†
25	Wilson, *Wilson's Albany*	l	H	d c	r c	f	E L	Am	....	*

Select Varieties.

1. *For the Northern Counties.*

Apples—*Summer and Autumn.* Yellow Transparent, Oldenburg, Alexander, Lady Elgin crab. *Winter.* Dudley's Winter (North Star,) Fameuse, Hayford Sweet, Wealthy.

Pears—Fulton, Eastern Belle, Nickerson, Tyson, Vermont Beauty.

Plums—Moore Arctic, Green Gage, Smith's Orleans, and possibly De Soto, Forest Garden and Wolf.

Small Fruits—Agawam blackberry; Cuthbert, Turner and Tyler raspberries; Fay and White Grape currants; Downing and Houghton gooseberries.

2. *For the Southern Counties.*

Apples—*Summer and Autumn.* Yellow Transparent, Oldenburg, William's Favorite, Dyer (Pomme Royal,) Gravenstein, Fall Harvey, High Top Sweet, Munson Sweet, Ramsdell Sweet.

Winter—Baldwin, Fameuse, Granite Beauty, Hubbardston, Jewett Red (Nodhead), Milding, Mother, Northern Spy, Rhode Island Greening, Rolfe, Roxbury Russet, Talman Sweet, Wealthy, Yellow Bellflower.

Pears—Clapp Favorite, Bartlett, Louise Bonne of Jersey, Sheldon, Angouleme, Anjou, Lawrence.

Plums—Bavay, Imperial Gage, Lombard, McLaughlin.

Cherries—Black Heart, Downer's Late, Governor Wood, Early Richmond, English Morello.

Raspberries—Cuthbert, Golden Queen, Shaffer, Gregg.

Blackberries—Agawam, Snyder.

Currants—Fay, Prince Albert, Versaillaise, Victoria, White Grape.

Gooseberries—Downing, Smith, Whitesmith.

Grapes—Green Mountain, Hartford, Moore's Early, Worden.

Strawberries—Bubach No. 5, Crescent, Haverland, Sharpless, Wilson.

* 3. *Select Apples for Home Use.*

Summer and Autumn: Yellow Transparent, Oldenburg, Dyer, Gravenstein, High Top Sweet, Munson Sweet.

*The varieties here suggested are known by the writer to be of value for the purposes named in certain parts of the State. There may be some sections where local conditions would render other sorts more valuable.

Winter—Fameuse, Hubbardston, Mother, Northern Spy, Rhode Island Greening, Rolfe, Roxbury Russet, Winter Sweet Paradise, Talman Sweet.

*4. *Select Apples for Market.*

Summer and Autumn : Oldenburg, Gravenstein, High Top Sweet.

Winter—Baldwin, Ben Davis, Hubbardston, Rhode Island Greening, Roxbury Russet, Talman Sweet, Yellow Bellflower.

5. *Apples Tried and Found Wanting in the Northern Counties.*

Baldwin, Ben Davis, Black Oxford, Blue Pearmain, Fall Queen, (Haas), Gravenstein, Grimes Golden, High Top Sweet, Mann, Northern Spy, Peabody Greening, Porter, Rhode Island Greening, Rolfe, Sops-of-Wine, Talman Sweet, Tompkins King, Williams (Favorite), Yellow Bellflower.

*See note on page 143.

Report of Botanist and Entomologist.

Prof. F. L. HARVEY.

Professor W. H. Jordan:

DEAR SIR—I have the honor to submit herewith my sixth annual report as Botanist and Entomologist for the Experiment Station. The demand for information about injurious fungi, weeds, forage plants and injurious insects is increasing. More letters of inquiry were received the past season than ever before. Many of these letters were about insects and fungi already considered and figured in previous reports and from parties who must have had access to the Station Reports. It is apparently less trouble to send specimens to the Station for examination and positive determination than to look them up in the reports. Extensive and carefully detailed correspondence must form an important feature of Station work. Such letters are usually answered by referring to the published accounts in the Station Reports. Specimens when new to the State are reported upon in detail, and if of sufficient interest are considered and figured in the annual report. Below will be found tabulated and considered the most important plants and insects that have been studied the past season The season has not been marked by the extreme ravages of any insect, or the widespread prevalence of any species of fungus, though some of those that gave trouble last season have increased and a few have been added to the list of our State pests.

PEAR-LEAF BLIGHT seems to be spreading in the western part of the State in the vicinity of Portland. Any whose pears crack open in ripening will do well to read the article on this disease in Experiment Station Report, 1892, page 109. The BEAN ANTHRACNOSE, a disease that causes brownish spots upon snap beans, (especially the white-podded varieties), was quite prevalent the past season. TOMATO ANTHRACNOSE, a fungus attacking ripening and ripe tomatoes was abundant in the Station garden and elsewhere in the State. The BEET SCAB, a disease causing warty excrescences upon beet roots, and said to be produced by the same fungus as POTATO SCAB was abundant in the Station garden and other places in the State. The CLOVER RUST was unusually bad (especially on second-growth clover,) about Orono. A new tomato disease causing depressed dark

patches upon ripened tomatoes did considerable damage to the Station tomato crop. The STRAWBERRY SEPTORIA was very abundant upon Station strawberries. The ORANGE HAWK-WEED still spreads. As it seeds before harvest, spreads by runners at the roots and is perennial it will yield to nothing but the spade and hoe, and the earlier attended to the less trouble. The ARISTATE PLANTAIN, a near relative of the ENGLISH PLANTAIN has made its appearance in the State. In response to an enquiry regarding wild rice we have learned that it is plentiful in the State.

THE FALL CANKER WORM is gradually spreading. Besides apparently holding its own in known localities several new localities have been reported the past season. This species is sometimes accompanied by the LIME-TREE WINTER-MOTH an insect similar in its habits but checked by spraying like the CANKER-WORM.

THE ANGOUMOIS GRAIN MOTH was found in great numbers in boxes of *Shaker Pop Corn* offered for sale in Orono. This is one of the worst grain insects. The grain exhibits at the World's Fair were badly infested with it. It is capable of doing much damage to stored grain and its spread in the State would be a misfortune.

THE STALK BORER, (*Gortyna nitela*, Guen.,) and THE BLACK CANTHARIS, (*Cantharis atrata*,) were both reported as doing damage to potatoes; the former boring into the stalks, the latter in great numbers feeding upon the foliage.

THE RED-HUMPED APPLE TREE CATERPILLAR seems to be increasing in the State. It was reported from a new locality this season and we found it also in the Station orchard, probably introduced on nursery stock.

THE APPLE-LEAF BUCCULATRIX. (*B. pomifoliella*, Clemens.) A small moth, the larva of which skeletonizes the leaves of apple trees was reported as doing considerable damage. This insect has not been noticed before.

Specimens of pears received from F. Frank Jones, Portland, bore the characteristic cuts of the PLUM CURCULIO. Some of the fruits had five incisions and were badly dwarfed and distorted.

THE STRIPED SQUASH BEETLE, a very common garden pest seems to have been unusually abundant the past season. Thick planting and then thinning, as the plants get older; protecting the seedlings by boxes or half hoops and netting, or even hand picking the beetles will usually insure a good stand of cucurbitaceous plants.

Mr. C. A. Wood of Searsport sent us a species of ROVE BEETLE, *Ancyrophorus planus*, and THE FOUR-SPOTTED PITHYOPHAGUS, *P. 4-guttatus*. Both were accused of destroying the kernels of sweet corn at the top of the ear. Ears of damaged corn accompanied the accused. We were able to acquit the above beetles as the corn showed the unmistakable work of the CORN WORM which was considered in our last report on P. 119. The true culprits, full fed, had probably crawled away to transform. The above insects were in the corn to feed upon the sugary and starchy matter that flowed from the broken kernels.

THE WHITE GRUB or larva of the MAY BEETLE, *Lachnosterna fusca*, has been doing much damage to grass lands in the vicinity of Bridgton. As there is no certain remedy known for this insect it would be advisable to do some field work upon it and try the most hopeful remedies suggested by entomologists and prove their value or worthlessness.

THE PEAR BLIGHT BEETLE working in the limbs of apple trees and boring the wood full of small channels is a new injurious insect to the State.

We reeceivd specimens from two widely separated localities so it must be widespread. Its presence can be detected by small shot-like holes in the bark. It attacks healthy trees and there is no remedy but to cut the branches infested and burn them.

The BEAN WEEVIL spoken of in our last report is considered and illustrated in this. The HORN FLY was quite abundant in some localities. It is migrating eastward and was quite abundant at Hudson and other localities in the Penobscot valley this season.

The CARROT FLY, *Psila rosæ*, was received from Mr. C. H. Morrell, Pittsfield. It was found infesting stored carrots. This is a European insect never before detected in the United States. The carrots were literally alive with maggots.

Beets in this region were badly infested by a species of *Anthomyia* or BEET FLY, the larvæ of which eat the pulp from the leaves, leaving the epidermis. The eaten spots are clear whitish and in them the maggots can often be seen between the epidermi.

THE CURRANT PLANT LOUSE, *Aphis ribes*, L. has been doing damage to gooseberries in Aroostook and Piscataquis counties the past season, destroying the foliage and causing a second growth of small leaves.

THE APPLE MAGGOT, *Trypeta Pomonella*. Walsh. still is doing much damage in Maine as well as in adjoining states, if we can judge from the demand for our article on this insect, published in the Station Report for 1889. We received a long newspaper article from a New Hampshire correspondent, which he had written to give the fruit growers of his state the life history of this pest. The article was accompanied by specimens in the "*long-winged*" stage of their development, graphically described by the writer. The specimens were a species of ICHNEUMON which does not even belong to the same order as Trypeta, which is a *two winged* fly. The article was full of other errors. We notice this merely to warn farmers and fruit growers against articles upon technical subjects by non-professionals. To trace the life history of an insect requires great care, and a knowledge of insect forms that can not possibly be obtained except by long experience.

In the above mentioned article at least *three insects* belonging to *different orders* were regarded as *stages* in the life history of *Trypeta* and *none of them pertained to that insect* The best way is to send injurious insects to the professional entomologist. *Absolute* identification of a p st is the first thing necessary in coping with it.

THE CHINCH BUG still continues to do damage to meadow lands in the vicinity of Fryeburg. It will be well to do some field work in that region another season to learn the extent of the infested district and gain any information that will enable us to suggest remedial measures.

Tetranychus 2-maculatus, Harvey, was reported from Piscataquis county the past season. While we were in Chicago, during July, specimens of this mite were submitted to us for examination. They came from a greenhouse near Chicago, showing this pest is widely distributed.

DIRECTIONS FOR SENDING SPECIMENS.

Regardless of the careful directions given in previous reports for sending insects, several specimens were received the past season, in envelopes or fragile paper boxes and when they arrived were crushed almost beyond recognition. Other packages came without the name and address of the sender upon them. Insects should *always* be sent in wooden or tin boxes and some of the food plant or injured material enclosed. Notes upon the habits of the insect

should accompany the specimens, and the sender's name and address should be upon the package even if a separate letter is written. We sometimes receive several packages the same day and if not plainly marked we are unable to tell from whom they come.

Directions for sending specimens will be found in the Annual Report of the Experiment Station, 1888, p 194, or in Maine Agricultural Report, 1888, p. 158. Correspondence regarding injurious insects and fungi is invited. Insects and plants will be named, and when injurious, remedies suggested. It is to the interest of farmers to detect injurious insects and fungi before they become established, so that remedial measures can be adopted before the pests are beyond control. As the Entomologist's duties prevent him from going much about the State, it is largely through correspondence that the Station learns of insects doing injury in the State.

REMARKS.

The cuts and plates to illustrate this Report were obtained from the following sources: From the Department of Agriculture, Washington, D. C.; the plate of Plantago Patigonica, cuts of the Angoumois Grain Moth, and cuts of the May Beetle; from J. B. Lippincott & Co.; cuts of the Lime-tree Winter-moth, the Apple-leaf Bucculatrix, the Disippus Butterfly and the Pear-blight Beetle; from Prof. A. E. Popenoe, cuts of the Bean and Pea Weevils; cuts of the bean Anthracnose and Carrot Fly are from original drawings made by the writer.

PLANTS REPORTED AND EXAMINED—1893.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	Hair Mold	*Phycomyces mitens*	Chas. P. Kitridge, Milo	On excrement. See Experiment Station Report, 1892, p. 111.
2	Pear-leaf Blight	*Entomosporium maculatum*, Lev.	T. Frank Jones, Portland	Attacking the leaves and fruit of pear trees. See Experiment Station report, 1892, p. 109.
3	Bean Anthracnose	*Colletotrichium Lyndemuthianum*, (S and M) (B and Cav.)	Eugene T. Perkins, Kennebunkport.. Prof. W. H. Jordan, Orono	Causing brown spots on the pods of beans.
4	Anthracnose of the Tomato	*Colletotrichum phomoides*, Sacc.	F. L. Harvey, Orono	Causing ripe rot on tomatoes.
5	Beet and Potato Scab	*Oospora scabies*, Thaxter	F. L. Harvey, Orono	Causing warty excrescences on beet roots and scab on potatoes.
6	Orange Hawkweed	*Hieracium aurantiacum*, L.	E. W. Dutton, New Sharon	Coming uninvited into fields.
7	Aristate Plantain	*Plantago Patigonica* var. *aristata*, Gray.	Mrs. A. M. Pikes, East Madison	In oat field.

INSECTS REPORTED AND EXAMINED—1893.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	Fall Canker Worm	*Anisopteryx pometaria*, Harris	B. Walker McKeen, Augusta, Chas. S. Pope, Manchester, W. F. Hilt, Warren, Samuel Milliken, W. Scarboro	Eggs on apple trees; wingless females on side of house; larvæ feeding on foliage of apple trees.
2	The Angoumois Grain Moth	*Gelechia cerealella*, L	F. L. Harvey	Found in *Sure Pop* Shaker Corn in a store in Orono.
3	The Stalk Borer	*Gortyna nitela*, Guen	H. B. Whipple, Bingham	Boring potato stalks.
4	The Io Emperor Moth	*Hyperchiria Io* (Linn)	F. H. Parlin, East Winthrop	
5	The Lime-tree Winter Moth	*Hybernia tillaria*, Harris	F. W. Hilt, Warren	With the females of the Fall canker worm crawling on the side of a house.
6	The Red-humped Apple-tree Caterpillar	*Œdemasia concina*, (Sm. and Abb.)	F. L. Harvey, College orchard, Miss May Thurlow Farrow, Centre Belmont	Feeding on foliage of apple trees. See Station Report, 1890, page 135.

7	THE GREAT AMERICAN TIGER-MOTH	*Arctia Americana*, Pack	D. H. Knowlton, Farmington	This is a rare moth in Maine. Of no special economic importance.
8	THE APPLE-LEAF BUCCULATRIX	*Bucculatrix Pomifoliella*, Clemens.	D. P. Boynton, Monmouth	Injuring the foliage of apple trees.
9	THE DISIPPUS BUTTERFLY.	*Limenitis disippus*, Godt	Fred B. Pike, Cornish	Feeding on willows.
10	THE PLUM CURCULIO	*Conotrachelus nenuphar*, Herbst	F. Frank Jones, Portland	Several varieties of pears showing the cuts of the plum curculio.
11	THE STRIPED SQUASH BEETLE	*Diabrotica vittata*, Fabr	J. W. Black, Searsport	Obtained from Mr. C. A. Woods.
12	ROVE BEETLE	*Ancyrophorus planus*, Lec	J. W. Black, Searsport, from C. A. Woods, Searsport	Feeding on the starchy matter of ears of corn that had been injured by the Corn Worm. See Experiment Station Report, 1893, p. 192.
13	FOUR SPOTTED PITHYOPHAGUS.	*Pithyophagus 4-guttatus*	J. W. Black, Searsport, from C. A. Woods, Searsport	With the above feeding upon the exuded milk of corn attacked by the Corn Worm.
14	THE WHITE GRUB OR MAY BEETLE	*Lachnostema fusca*, Trohl	J. L. Wale, Bridgton	Destroying meadows.
15	BLACK CANTHARIS.	*Cantharis atrata*	H. B. Gray, Blue Hill	Feeding on potato vines.
16	BEAN WEEVIL	*Bruchus obtectus*, Say	Samuel Libby, Orono	Working in stored beans.
17	THE PEAR BLIGHT BEETLE	*Xyleborus pyri*, Peck, = *Xyleborus dispar*, Fabr	J. M. Allen, North Sedgwick, Dr. Twitchell, Augusta	Boring in the limbs of apple trees.
18	THE HORN FLY	*Haematobia serrata*	A. T. Wing, North Fayette	See Experiment Station Report, 1892, p. 131.
19	THE CARROT FLY	*Psila rosae*, Fab	C. H. Morrell, Pittsfield	Larvæ badly infesting stored carrots. New to United States.
20	THE BEET OR MANGOLD FLY	*Anthomyia betae*, Curtis	O. T. Goodrich, Orono, F. L. Harvey, Orono	Feeding on the pulp of beet leaves reducing them to a dry papery skin.
21	OYSTER-SHELL BARK-LOUSE	*Mytilaspis pomorum*, Bouchè	Miss Georgine V. Wilbur, Phillips	On apple trees. See Experiment Station Report, 1888, p. 157.
22	THE CURRANT PLANT LOUSE	*Aphis ribis*, L	Chas. P. Kittredge, Milo Delano Moore	Attacking gooseberry leaves. Causing clusters of second growth leaves.
23	THE COTTONY MAPLE SCALE	*Pulvinaria innumerabilis*, Rathvon	C. M. Randlette, Richmond	On maple leaves.

BOTANY.

BEAN ANTHRACNOSE.

Colletotrichium Lindemuthianum, (Sacc & Magn) Briosa & Cavara.

FIG. 1—Bean Anthracnose, pod showing pits formed by the disease (original)

The above disease of the bean has been quite common in gardens and fields about Orono for the past seven years and we presume it is prevalent throughout the State. It was unusually bad the past season, and specimens were received from distant localities and inquiries made regarding it. It is probably the worst disease of the bean and as its ravages can be largely controlled by proper precautions and treatment, the following consideration of the fungus may prove helpful in combating it. The BEAN ANTHRACNOSE is a parasitic fungus attacking the stem, leaves and pods of both bush and pole beans, producing, especially on the pods, sunken brownish pits or spots surrounded by a reddish brown border. See Fig. 1. In the central part of these pits are little pinkish dots which are the spore masses that have exuded from below. The spores are held together by a gummy substance that is soluble in water and they may be liberated by dew or rain or excessive moisture and then are free to be blown by the wind to healthy plants, where they germinate and spread the disease. The disease is worst upon the white podded bush and pole beans but will also attack the more hardy varieties. The past season it was quite bad upon YELLOW EYES in the field. We lost the greater part of our garden crop of German Wax the past season, the pods becoming so covered with pits before they were large enough to pick as to be worthless. The effects of this disease are to lessen the stand when it destroys the seedlings ; to dwarf the plants and make the pods swollen and when it spots the pods to render them unfit for snap beans, also to finally injure the bean in the pods. This disease may originate from infected seed or, we think, it may live over winter in the beans and pods that are left in the garden. When infected seed is planted the disease shows itself early in the seedlings. Much of the seed of German Wax beans offered for sale is infected. The past season fully half of the seedlings in our garden were affected

when they appeared above ground and not more than two-thirds of the seed came up. The remaining plants were dwarfed and early showed the presence of the disease. We procured new seed and made a second planting.

We have *purchased* our seed for the past seven years from that offered for sale by prominent dealers and have never had a crop free from the disease. It is common among gardeners to leave the bushes with the diseased pods upon them to rot on the ground, and to plant a second crop in the same place. We practice rotation of crops even in the garden with good results. It is a good practice to clear a garden in the fall of all refuse and carefully burn it. By doing this, fungi that live in the decaying organic matter are destroyed, along with hybernating insect pests. Beans should be planted on a light dry soil, in hills, or if in rows far enough apart to give good circulation of air. Moisture favors the growth of *Anthracnose* and other bean diseases. Care should be taken not to hoe beans after a rain or when the dew is on for the dirt that sticks to the leaves is liable to contain spores that will germinate and rapidly spread the disease. Professor Jordan showed us some badly spotted pods that were apparently free from the disease when purchased in the Orono market a day or two before.

If possible secure seed from your own, or a neighbor's field that was free from disease. It is hazardous to plant seed from an infested field. If obliged to take seed from a field that has been diseased pains should be taken to select pods from plants that have escaped the disease. All beans that show sunken pits, discolored patches, or are even wrinkled or blistered should be rejected. Diseased seedlings should be pulled as early as possible and removed from the field or burned, as the fungus will ripen its spores in the decaying plant. Some practice spraying beans with *Bordeaux mixture* early in the season, and claim that the fungus is controlled by it. The following precautions should materially lessen the disease:

I. Select good seed, rejecting all beans that seem at all unsound.

II. Should the disease appear in the young beans carefully destroy all affected seedlings.

III. If convenient spray early with Bordeaux mixture and repeat the application if needed before the pods form.

IV. Do not plant on ground that has borne an infected crop the past season.

V. Plant on a dry soil in hills or in rows far enough apart to admit air freely. Hoe when the ground and foliage are dry.

Tomato Anthracnose.

Colletotrichum phomoides, Sacc.

This fungus appeared last fall in the station garden upon ripening and fully ripe tomatoes and did considerable damage. Tomatoes that were apparently sound developed the disease rapidly after they were gathered. This fungus is capable of doing much damage to the ripening crop and the ripe fruit can not be kept any time or marketed. We understand from Professor Munson that the disease has done damage elsewhere in the State. Professor Chester described this fungus as *C. lycopersici*, n. s p. in the Fourth Report of the Delaware Station, but in the Fifth Report of the same station, p. 80, 1892, he refers the fungus back to *C. phomoides*. Sacc. Our species is the same as the one considered by Professor Chester, as we sent specimens to him for comparison. He has kindly loaned us the fine cuts which are used to illustrate this article.

Professor Chester is of the opinion that the characters used by botanists to separate the genera *Colletotrichum and Glœsporium*, viz.: the presence or absence of setæ in the fruiting tufts, is evanescent. If this should be established the genus *Colletotrichum* would be merged into *Glœsporium*. The investigations of Miss Southworth, Professor Halsted and Professor Chester indicate that several forms of *Glœsporium* separated as species on account of living on different host plants will have to be merged, or that there is a species of *Glœsporium one and the same*, capable of a wide range of parasitism and of producing *Anthracnose* on a variety of hosts. It looks as though careful laboratory methods would make havoc with the present nomenclature of fungi, by merging stages of the life history of forms and uniting species that have been separated on the principle, that each host harbors its peculiar parasites. The above is only of importance to mycologists. The characters and treatment are of more interest to the grower of tomatoes.

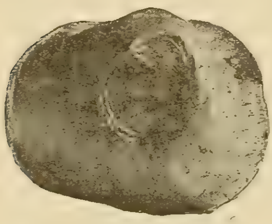


Fig. 2. Tomato. Affected by Anthracnose. Colletotrichum phomoides, Sacc.

CHARACTERS.

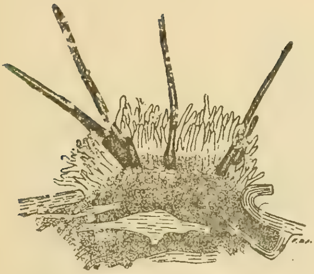


Fig. 3. A fruiting tuft of Colletotrichum phomoides, Sacc. Tomato-Anthracnose.

This disease makes its appearance upon ripening or fully ripe tomatoes upon the vines or develops rapidly upon gathered fruit. It appears on the tomatoes as rounded, sunken, discolored, wrinkled spots with a black centre. See Fig. 2. Contiguous spots become confluent forming diseased areas. An examination of these dark parts in the diseased areas, discloses numerous microscopic, oblong bodies, the *spores* of the fungus. See Fig. 4. These spores reproduce the disease. Prof. Chester found that these spores inserted under the skin of healthy tomatoes would rapidly cause the disease. Not being able to develop the disease by putting the spores on the unbroken skin of the green and ripe tomatoes would indicate that the disease is an internal parasite and can not be reached by spraying with Potassium Sulphide as is recommended by Mr. Bragg of the Oregon Station in a recent bulletin.

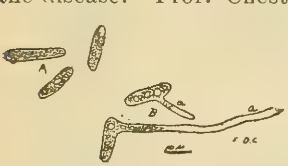


FIG. 4. A. Mature spore. B. Germinating spore of Colletotrichum phomoides, Sacc.

This disease opens the way for the attack of other species of fungi that hasten the decay.

Fig. 3. shows a cross section of one of the diseased spots highly magnified.

REMEDIES.

1. Spray the vines and young fruit with Potassium Sulphide (Liver of Sulphur)—formula.—Dissolve seven ounces of Potassium Sulphide in twenty-two gallons of water and apply with a spraying apparatus. As stated above this may not be useful for this disease but is regarded a remedy for external tomato fungi.
2. Gather all diseased vines and tomatoes and burn them.
3. Change the location of the tomato patch if the crop has been affected.
4. Do not take seed for planting from diseased tomatoes.

Potato and Beet Scab.

Oospora scabies, Thaxter.

The scab of potatoes and beets has been quite prevalent the past season. The ordinary disease of potatoes and beets known as "scab" has been demonstrated by Dr. Thaxter to be due to the same fungus, the species named above. Now that the cause is known experiments for checking the disease can be conducted upon a rational basis. Professor Bolley exhibited at the World's Fair, Chicago, in the exhibit of the office of experiment stations, two jars of potatoes grown under similar conditions from scabby seed. One lot was treated with a dilute solution of corrosive sublimate and the other lot was untreated. The former lot was comparatively free from scab and well grown. The latter badly scabbed and dwarfed.

This would indicate that scabby seed may be the cause of the disease and that clean seed should be planted. It would also follow that scabby seed *treated* will produce much better potatoes than scabby seed *untreated*.

We feel positive that the disease cannot be controlled merely by planting clean seed. The last season we planted clean seed upon soil that had not grown potatoes for two years and raised a badly scabbed crop. It seems certain that this disease may live in the organic matter of the soil even more than one year or else has other hosts which have not been discovered upon which it maintains itself.

Will treating clean seed with corrosive sublimate give a better crop than clean seed untreated? If not we see no great use for it, for clean seed is usually obtainable.

Experiments to show the vitality of this fungus in soil not growing potatoes are desirable in order to learn whether a system of rotation may not clean the soil of the disease. Experiments should be conducted with clean seed upon grass lands in order to learn whether they are free from the fungus and settle the question whether newly turned grass land is better for potatoes. The study of fertilizers in relation to the introduction of this disease is important. Considerable more study upon the conditions of growth of this fungus is necessary.

WESTERN PLANTAIN.

Plantago Patigonica, var. aristata, Gray.

Figs. a, b and c show spikes in different stages of growth. Fig. 1. Back view of flower with calyx removed Fig. 2, front views with calyx and basal bract. Figs. 3 and 4, portions of capsules. Figs. 5 and 6, dorsal and ventral views of the seed.

Western Plantain.

Plantago Patigonica, *var. aristata*, Gray.

Specimens of the above plant were received the past season from Mrs A. M Pikes, East Madison, Somerset county, and found growing in an oat field. This plant belongs to the *Order Plantaginaeœ* and is a near relative of the English Plantain considered in Experiment Station Report, 1890, p. 119. It was probably introduced with the seed. A few specimens were found growing on the college campus a year or two ago, introduced with grass seed, but they were not allowed to drop their seed. This plant is widely distributed in South and North America and in the West is a bad weed It presents a number of varieties besides the one named above. As it has become established on Martha's Vineyard and about Boston it would no doubt find a congenial home in Southern Maine, and this is written to call attention to it.

It can never become so bad a weed as its relative, the English Plantain, which has a strong foothold in some parts of Maine as it is an *annual* and could be eradicated in a single season if prevented from seeding. It may be known by the following description:

About a foot high, having usually several slender, naked, flowering stalks. which start from a cluster of leaves near the ground and bear on their top a close spike of flowers. The leaves are narrow, from three to five inches long, and bear a few nearly prominent parallel ribs. The variety under consideration is clothed with silky hairs and below each flower in the spike is a bract two or three times the length of the flower. The seed are boat-shaped as in the English Plantain. The seeds germinate the same season they ripen and the young plants mature the next season. It seeds profusely and a few plants would give it a good start. That the plant may be readily detected we reproduce from the United States Agricultural Report, 1888, plate XI, a cut of this weed, which is shown on the opposite page.

ENTOMOLOGY.

The Angoumois Grain Moth.

(*Gelechia cerealella*, Linn.)

Order Lepidoptera: Family Tineidæ.

The above insect was detected the past season as detailed below. Experiments made by Mr. F. M. Webster show that the New England climate will not destroy this pest but only check its depredations during cold weather. His experiments also show that the pest can be destroyed by a temperature of 130° Fah. kept up for four or five hours. The accompanying cuts show the life history of this moth, and the nature of its work.

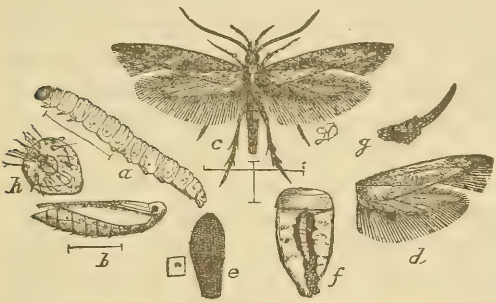


Fig. 5. Stages in the life history of the Angoumois Grain-moth, Gelechia cerealella, L.

Below we give an article upon this insect contributed to the *Maine Farmer* by the writer.

Editor Maine Farmer: My attention was called a few days ago to the above insect found in great numbers in boxed Shaker rice

pop corn, put up by R. H. Wright, Albany, N. Y., and obtained for retail in Orono from a wholesale house in Bangor. As this is one of the most destructive insects known to wheat, oats, barley and Indian corn, it seems desirable that attention be called to it. Upon opening the boxes swarms of full fledged moths were found on the top of the corn, and made their escape into the room. The kernels of corn each contained small circular holes, and the most of the starchy matter was eaten, leaving only the shell. Mixed with the corn were a large number of dead moths. The party who found the moths let the live ones from several boxes of corn escape in the store, and when I told him it was a bad pest, he said they would all die, as the store was cold nights, and that he had burned all the corn. Though this insect was introduced from France, and has done more damage South than North, yet it is undaunted by a cold climate, and would be capable of doing much damage in stored grain in Maine. This insect was abundant in the grain exhibits at the World's Fair the past season. To burn the corn after the moths had all escaped was useless. That this insect may be better known, so that precautions can be taken against it, we give the following regarding its life history:

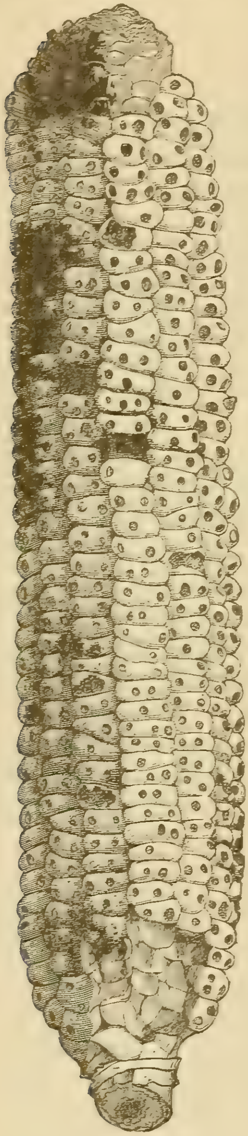


FIG. 6. Work of the Angoumois Grain-moth, Gelechia cerealella, L.

Perfect insect, a small moth with pointed wings, that spread between a half and three-quarters of an inch. Fore-wing pale shining ochre, with a grayish or brownish gray streak in the folds at the base, and a few scales of the same color toward the tip of the wing on the margin. Hind wings grayish ochre, and bearing a fringe of the same color on the border. *Larva,* a smooth, white worm, attacking the kernels, and consuming the inside, leaving the shell, and when full fed transforming to the *pupa* state in the grain, and finally emerging as a moth through a small hole in the kernel.

REMEDIES.

Bisulphide of carbon is now quite largely used to destroy insects infesting stored grains. In France they put the grain into an *insect* mill something like a peanut or coffee roaster, and raise the temperature of the grain high enough to kill the moths, eggs and larvæ. When the quantity of grain is small, it might be thrown into *hot water* or *heated*, and then fed to fowls. The work of this insect resembles in its effects that of the pea weevil, only the hole made by the moth is smaller, and so far as we know these insects never encroach upon each other's domain, the moth infesting the seeds of graminaceous plants, while the pea weevil is partial to legumes. Whether this corn was infested before it left the *Shakers*, or whether it lay in the wholesale houses in Bangor during the past summer, and was infested by moths of home production we do not know, but the moth is here *sure pop*, and we will have to look after it.

F. L. Harvey.

Orono, December 11th.

The Lime-Tree Winter-Moth.

Hybernia Tillaria, Harris.

Order Lepidoptera: Family Geometridae.

Among some specimens of female Canker-worms received from Mr. F. W. Hilt of Warren, Maine, were several wingless females of the above species. The specimens were found on the side of a house where they had probably crawled to lay their eggs or meet the males. As the Canker-worm is very bad in Maine and as this insect has similar habits they should be distinguished.

DESCRIPTION.

Eggs pale yellow, oval and marked with a net work of raised lines. They can be distinguished from the eggs of the Canker-worm by their color and form. (See Experiment Station Report, 1888, p. 167, Fig. 20.) The eggs are laid in similar situations as those of the Canker-worm. As the females of both species had

commenced to lay eggs in the box in which they were sent we concluded they were probably crawling up the side of the house to deposit the eggs.

Larva, when full grown, about an inch and a quarter long. Head dull red with a V-shaped mark on the front, yellow above and marked with many longitudinal black lines; the under side paler. Like the larva of the Canker-worm it is a *span* or *inch* worm but larger than the caterpillar of that species. The accompanying cut (Fig. 7) shows the larvae feeding and at rest.

FIG. 7. The Lime-tree Winter-moth, Hybernia tiliaria, Harris. Male, wingless female and larvae.

Female Moth, wingless, spider-like, yellowish white, sides marked with black dots, each ring of the body, excepting the last, bears two black dots, which has only one. Head black in front and the legs ringed with black. Antennae thread like. Ovipositor jointed and retractile. The larger size, the spotted back and black rings on the legs readily distinguish this from the wingless females of the fall and spring Canker-worms. Fig. 7 shows the wingless female about natural size.

Male Moth, expanse of fore wings an inch and a half. Color, rusty buff sprinkled with brownish dots and with two transverse brown wavy lines, the inner most distinct. Between the bands and near the anterior edge is usually a brownish dot. Hind wings paler. Body color of fore wings The antennæ are feathered. Like most of the moths of the inch worms the wings are very delicate. The male moth about natural size is shown in Fig. 7. The moths of the Canker-worm would be on the wing at the same time but they are smaller.

LIFE HISTORY.

The eggs hatch early in the spring and the young larvae feed upon the foliage of the apple tree, basswood, elm, hickory, etc., and are full grown about the middle of June, when they usually let themselves down by a silken thread, enter the ground about five or six inches, form a little oblong cell within which they change to the chrysalis state. In October or November (sometimes not until the following spring) when the moths appear. The wingless females climb the trees or other objects where they meet the winged males, pair and soon deposit the eggs in clusters, (usually upon the branches of the tree they have infested,) completing the life history.

REMEDIES.

The life history of this species is so nearly like that of the Canker-worm that the remedies suggested for that insect are applicable to this. It has never done as much damage as the Canker-worm but it is capable of doing much injury to the foliage of apple trees and from the specimens received we should judge that it is quite abundant about Warren, Maine.

The Apple-Leaf Bucculatrix.

Bucculatrix Pomifoliella Clemmens.

Order Lepidoptera : Family Tineidæ.

We received from Mr. D. P Boynton, Monmouth, Me., a lot of apple tree leaves badly eaten by the larvæ of the above moth. In the box were quite a number of the larvæ and cocoons. This is the first time we have seen this species in Maine and as it is capable of doing considerable damage to the foliage of apple trees, we give the following account of it, so that it may be known and measures adopted to prevent it spreading.

HISTORY.

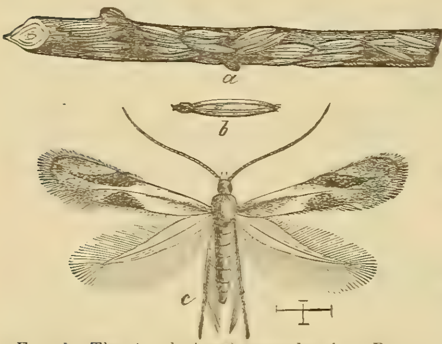


FIG. 8. The Apple-Leaf Bucculatrix. Bucculatrix pomifoliella. Clemmens. Moth enlarged, cocoons natural size and enlarged.

This moth was described by Clemens in 1860. It is known to be widely distributed having been reported from Texas, Missouri, Massachusetts, New York and now from Maine. It has done considerable damage to the foliage of apple trees especially in New York.

DESCRIPTION.

Eggs—So far as we know the eggs of this species have never been described. They must be quite small as the cocoons of this diminutive moth have been mistaken for insect eggs. They are said to be laid upon the leaves. We have never seen them.

Larva—About one-half inch long when mature, cylindrical, tapering at both ends. Joints of the body rounded and prominent, color dark yellowish with a greenish tinge, and reddish shades on the anterior segments. Body armed with short black hairs which are more numerous on the back of the first segment. Head small, brown and elipsoidal. The larvæ are active and when disturbed suspend themselves by a silken thread.

Cocoons—Dirty white, slender, about one-fourth inch long, ribbed longitudinally by about six prominent ridges, oblong, tapering and thinning at both ends, flattened on the side to which it is attached. Usually fastened to the twigs and branches in groups as

shown in Fig. 8 a. Fig 8 b shows one of the cocoons enlarged. The specimens we had were confined in a box and the cocoons were attached to the leaves and side of the box. If it can be shown that in nature the cocoons are never attached to the leaves it would indicate a remarkable instinct, for if attached to the leaves which fall they would probably be destroyed, while attached to the twigs they would be safe during the winter. The cocoons contain the

Chrysalis which is dark brown, rough, punctured on the back, twelve hundredths of an inch long. When ready to transform the chrysalis works itself partly out of the cocoon and the moth comes forth.

Perfect insect a small moth that is only about one-fourth inch expanse of wings. Fore wings whitish tinged with pale yellow and dusty brown. On the middle of the inner margin is a conspicuous oval brown spot. A wide streak of the same color on the opposite margin which extends nearly to the end of the wing where it tapers and points to a small circular brown spot near the tip. The moth much enlarged is shown in Fig 8 c. The hair lines to the right show the natural size.

LIFE HISTORY.

This insect spends the winter in the chrysalis state in the cocoons usually attached to the twigs and branches of the host plant. There is reason to believe that the larvæ when full grown sometimes desert the host plant and form their cocoons on other plants close by. About the time the leaves unfold the moths come forth and lay their eggs upon the tender foliage. The larvæ are full grown in July. The specimens sent us in July were in the larval form and went into the chrysalis state in August and have not yet (January) emerged, which would indicate only one brood in Maine. Prof. Riley thinks there are two or three broods in the latitude of St. Louis, Mo. In the latitude of New York, Prof. Lentner states that there are two broods, one in July and one in September. Our specimens would belong to the July brood and possibly may be diseased and may not emerge. Possibly we have two broods in Maine. In September or October the cocoons are formed in which the pupæ spend the winter. The larvæ feed externally upon the foliage, at least the leaves we received had the upper epidermis and pulp eaten away in patches, the veins and lower epidermis intact.

REMEDIES.

Natural—This small moth is preyed upon by several parasites that attack the larvæ and hold the pest in check. Some of the cocoons probably suffer somewhat from inclemency of the weather. Possibly birds may eat them but we find no record of observations.

Artificial—(a) Jar the trees when the larvæ are full grown and they will suspend themselves by threads and can be swept down by a broom and killed by hot water or crushed.

(b) Apply kerosene emulsion with a spraying pump to the branches in winter that bear the cocoons. The same application might be made for the first brood when the foliage is on. Strong soap suds alone probably would kill them.

(c) If in small numbers the cocoons can be removed during the winter months by the hand.

THE DISIPPUS BUTTERFLY.

Limenitis disippus, Godt.

Order Lepidoptera.

We receive the larvæ of the above species occasionally on account of the fact, that the second brood of larvæ hybernate when about half grown and make a beautiful hybernaculum that is sure to attract attention, also the larvæ is highly ornamented with colors and tubercles, and quite noticeable. The eggs are beautifully reticulated, small and laid on the under side of the leaf near the end. Most people are surprised to learn that those grotesque larvæ and odd hybernacula pertain to one of our common butter-

FIG. 9.

flies. Fig. 9 a shows the form of the full grown larvæ, b, the chrysalis, c, the hybernaculum in which the half grown larvæ of the fall

brood spends the winter. Fig. 10 shows the orange-red butterfly full size. The wings bear heavy black veins and a black border spotted with white.

FIG. 10.

LIFE HISTORY.

The hybernating larvæ complete their growth go into the chrysalis state and the butterflies are on the wing by July. These deposit their eggs sometimes on the leaves of plums but usually upon willow or poplar. The eggs soon hatch and in a month the larvæ are full grown, enter the chrysalis state and in a short time the second brood of butterflies appear. These lay eggs which soon hatch and when the larvæ are less than half grown they make hybernacula from the leaves in which they spend the winter.

THE MAY BEETLE.

Lachnosterna fusca, (Frohl.)

Order Coleoptera : Family Scarabæidæ.

We received the following letter last September in reference to the above insert :

"BRIDGTON, Maine, September 18, 1893.

Professor Harvey :

DEAR SIR—I send you specimens of a worm that is doing a great amount of damage to the farms in this vicinity. There are many acres of grass land in this town where a good crop of Timothy was cut the present season which now show hardly a green blade of grass. These worms are found just below the surface

where they feed upon the roots of Timothy. Can you tell us the name of the worm, its habits and if there is any way of extermination or curtailing its ravages? Will you please answer at once as we wish to find out how to treat the land this autumn.

"An early reply will greatly interest many farmers in this section of the State. Respectfully, J. L. WALES."

In response we sent Mr. Wales what information we had regarding the methods of coping with this pest. Mr. Wales published a newspaper article on this insect from which we make extracts to show the extent of the ravages of this insect in the State.

WHAT SHALL BE DONE WITH THE "WHITE GRUB."

This is becoming a very serious question with many farmers and gardeners at the present day in the town of Bridgton and vicinity.

A few days since Mr. A. M. Thomes, the owner of a nice farm on High street invited me to visit his grass fields. In one corner of a fine, large field which had borne a heavy crop of Timothy the present season, we found rather more than a half-acre upon which there was not visible a sign of vegetable life. What had composed the turf or sward could be stripped off and rolled up like a carpet, leaving the soil naked and brown and bringing to light upon each square foot of surface from a dozen to twenty flat white grubs. Several of these were put in alcohol and sent to Prof. F. L. Harvey of the State Agricultural College at Orono, who kindly and promptly sent what information he had at hand relative to the name, habits, and remedies, for this pest of the farmer. The grub especially loves to feed upon the roots of Timothy or herds grass, as may be seen upon the farms of Mr. Thomes, M. B. Stone, Nathan Palmer, Geo. Hilton and many others; it also loves the roots of the strawberry. Mr S. E. Lee of High street lost about one thousand fine strawberry plants the present season. The roots of corn are often devoured by the grub as may be seen on the farm of Mr. Geo. Chaplin, Naples Mr. John Palmer of South Bridgton lost a part of his potato crop in the same way.

Complaints from other parties and from other sections of the State show that the "White Grub" is wide spread and doing much damage in the State.

This insect is so familiar to everybody that we will take space to give an account of its life history but publish herewith a cut

so as to show clearly what insect is meant. Figure 11. 1 shows the pupa, 2 the grub, 3 and 4 side and dorsal views of the beetle. This insect is known as the "May Beetle," "June Bug" and "White Grub." In the larvæ state it feeds upon the roots of plants having done much damage to grass lands and especially to strawberry vines The beetle feeds upon the foliage of trees and where abundant often entirely stripping them of their leaves. The beetle is attracted by lights and is a frequent evening visitor to our living rooms while on the wing. The impression prevails that the eggs are laid on grass near the roots though perhaps this matter may bear further study.

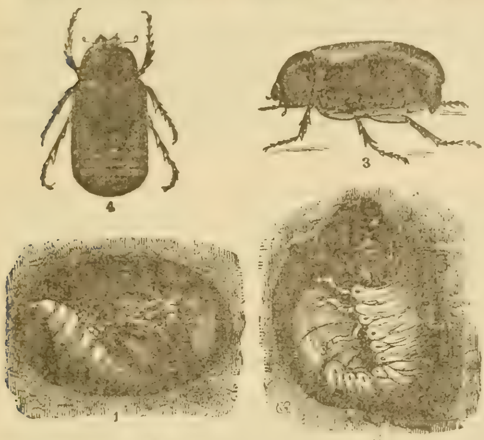


FIG. 11. The May Beetle. Lachnosterna fusca, (Frohl.) 1 pupa. 2 larvæ, 3 and 4 Beetle.

REMEDIES.

The Department of Agriculture at Washington, D. C., has conducted some experiments to show that kerosene emulsion liberally applied to the soil infested with "white grubs" will destroy them. The remedy would be too troublesome and expensive for application in large meadows but for small areas is worthy of trial. We extract the following from Prof Riley's letter regarding the subject: "The application of kerosene emulsion for white grubs is impracticable over very large areas owing to the necessity of washing the emulsion into the soil to considerable depth by a copious application of water, unless the application can be made with tolerable certainty of its being followed by slow and continuous rains such as will carry it into the soil gradually without washing it away. These conditions will not often be available at the time wanted, but for all limited applications as to lawns or limited patches of ground affected by the larvæ, there is no better remedy than the kerosene emulsion treatment. I have no accurate data as to the amount required per acre but if the emulsion is applied sufficiently to thoroughly wet the surface of the soil to the depth of an inch or

more and then carried down by applications of water to a depth of about eight inches during the next two or three days, the treatment will certainly prove effective. The amount necessary will vary with the different soils, both of the emulsion and the water applied later on to carry it down, easily permeable, sandy soils requiring less than denser clay soils.

Professor J. B. Smith has found potash fertilizers in the form of *Kainit*, applied as a top dressing efficacious against root affecting insects, such as wire worms. We wrote Professor Smith regarding the matter and below is his reply.

New Brunswick, N. J., September 22, 1893.

Dear Sir—Your card of the 20th inst., is at hand. The latest on Lachnosterna you will find in Forbes' 17th Illustrated Report, issued in 1891. I have had no personal experience with these insects from the economic side, and cannot give you any positive or tried suggestions. You know my hobby, and if the matter came to me in New Jersey, I would advise heavy top dressings of Kainit and Nitrate of Soda applied in combination after the flight of the beetles is over in spring, or the former alone applied early in September. Yours very truly, John B. Smith.

Professor F. L. Harvey, Orono, Maine.

Mr. Wales in his article suggests the following: "In the days of our fathers when the 'burnt pieces' were lighted up at night time by the partially extinguished fires, the farms and orchards were not infested by so many hostile enemies; and would not fires kindled in the neighborhood of orchards for a few evenings in late May or early June destroy the beetles and thus prevent the production of the white grub?"

The rooting propensities of swine can be put to practical account in destroying this pest. If I had meadow land on which the sod was dead and could be rolled up like a carpet, I would construct a movable fence and enclose the small areas and turn in a few hogs. The land would have to be reseeded and the swine could do no damage, and they would probably devour a large number of the grubs.

Skunks and crows are known to be enemies of the "white grubs" but owing to the demand by furriers for the pelts of the former and our anti-crows law against the latter we have not much to hope for in those directions.

We hope the farmers whose fields are infested will try some of these measures. There is one consolation and that is the life history of this pest is completed in three years and it would not probably lay its eggs on the same ground again, but seek some new field of conquest.

The Bean Weevil.

Bruchus obtectus, Say.

Order Coleoptera: Family Bruchidæ.

We received specimens of beans infested by the above insect from Hon. Samuel Libby, Orono. He gives the following interesting history regarding them: "The beans are of the horticultural variety and were gathered in the pods when ripe in September, 1891, and taken to my store where they lay until October, 1891. I then sorted out those that had six beans in a pod for seed and also those with five beans in a pod for second choice. The lot having five beans in a pod were put in an open basket in the store. They remained there during the summer of 1892 and about January 1, 1893 I had occasion to examine them and found they were infested. About one-tenth of the pods had holes in them and I found fine dust falling from the beans, and saw the holes in them. I also noticed small black objects in the basket. Not knowing that there was a bean weevil that worked on beans as the pea weevil does on peas I laid them aside for you.

The pods having six beans in them were shelled and planted in the spring of 1892 and showed no signs of weevil work. I have grown horticultural beans for twenty years and have always raised my own seed. In 1891, 4, planted beans obtained elsewhere and the beetle might have been introduced with that seed. "The crop of 1892 shows no evidence of weevil work."

We examined the specimens submitted and found them to be *Bruchus obtectus*, Say. The beans contained eggs; minute larvæ just hatched; larvæ one-third, one-half and full grown; pupæ in various stages of development; full grown pale colored beetles: some full colored ready to emerge; others free in the basket alive and some apparently dead. There were as many as twenty individuals in some of the beans. There were numerous holes in some of the beans from which the beetles had escaped, also many oval

translucent places where the coating of the bean had been made thin by the beetles indicating their location within. The inside of some of the beans was completely eaten and only the powdery excreta remaining. We wish to add our testimony to that of Popenœ, Schwartz and Lintner that successive generations of this insect occur in stored beans, and also that if the food supply does not become exhausted they may survive into the *second season.* They will eat cotyledons, radicle and plumule. Several specimens showed the cotyledons entirely detach from the radicle and it intact. We believe the radicle is rejected not because it is less desirable for food but on account of it being small and nearly isolated from the bean mass. We found one specimen with the cotyledons nearly intact and the radicle eaten, its place being occupied by a well fed larva. In some specimens *nothing* remained excepting the seed coats filled with powdery excreta.

It has not been clearly shown that the beetles will not fly or crawl to new lots of stored beans and infest them.

Or in other words it is not known whether beans may become infested after they are stored by the beetles laying their eggs upon them. The general belief is that the beetles confine their attacks to the lot of beans infested and that they spread during the summer through the agency of eggs laid on the growing pods.

Prof. Lintner has shown that the beetles will lay their eggs upon dry beans and that in the infested lot that the young larvæ will gnaw into them and perfect themselves.

The fact that a part of the lot of beans which Mr. Libby took to his store was not infested when shelled the next spring would lead one to suspect that the others may have been infested by beetles getting into them after they were stored. The holes in the pods may have been made for the entrance of beetles as well as for their exit. The holes being in the pods shows that the beetles as well as the larvæ have adequate gnawing powers. The only thing that would prevent infection this way would be the sluggish habits of the beetles. Those we had in a warm room in January were quite active. They did not fly but crawled rapidly. Prof. Lintner's observations show clearly that they may spread from the beans originally infested in a lot to the others stored with them. It is also important to know whether the beetles that mature at all seasons of the year may not fly to new lots of stored beans and infest them.

The fact that successive generations occur in stored beans; that sound beans in the same lot may become infested and that possibly new lots may also become infested, makes this weevil a more formidable pest than was formerly supposed.

Beans are largely grown and consumed in Maine and should this insect become common much damage might be done. Below we give its history, characters and remedies.

HISTORY.

This species is probably not native but was introduced as early as 1860, at least, possibly from *Asia*. It would seem that it has erroneously been considered the same as *B. obsoletus*, Say., bred from *Astragalus* seeds from Indiana as early as 1831. This view is strengthened by the fact that it was found in 1876 at Philadelphia in beans from various countries from both continents. At present it is cosmopolitan. It was first noticed in Rhode Island in 1860 by Dr. Fitch, who described it as *Bruchus Fabæ*. Within the next ten years it was carried to nearly all parts of the United States. In 1870 it was known from several of the New England States. So far as we know it has not previously been reported from Maine. Professor Fletcher has not found it in Canada. As the beetles are sluggish and disinclined to fly it is mainly distributed in infested beans. Those wishing a fuller consideration of this insect will find an interesting summary of the facts known regarding it in Professor Lintner's 7th Report of the Injurious and Other Insects of the State of New York, p. 255.

Characters—A small beetle that would be usually found infesting beans or associated with them. See Fig. 12. There are two

FIG. 12. Bean Weevil, much magnified.

closely related species of *Bruchus* that have been found infesting beans in this country. The above species is by far the most

common. It is one-tenth of an inch long, oval in form, head bent downward and more or less concealed from above, prolonged into a short, squarely-cut beak. Antennæ distinctly jointed, enlarged at the tip, the four basal and the terminal joints reddish or yellowish. Thorax and abdomen about the same width where they join. Wing covers marked by ten impressed and punctured lines in flattened ribs, which are clothed with a short pubescence, arranged in yellowish, black and whitish spots and lines—the white lines more distinct on the third rib. The abdomen is pale, dull yellow, with a black band on the fore part of each joint. It projects beyond the wing covers and that part is obscure grayish with a faint, medium whitish stripe. The hind thighs near their end armed with a long and two short spines. Feet reddish.

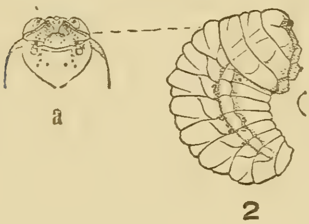


FIG. 13.

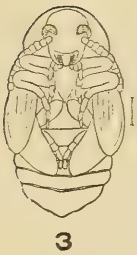


FIG. 15. Bean Weevil pupa.

FIG 14. Bean Weevil. Work of the insect.

The larvæ are white and broadly oval, see Fig. 13. The eggs white, thicker at one end and about three times as long as wide.

The work of this insect appear on the surface of the beans as small holes from which the beetles have escaped, and small oval, translucent spots on the surface over the cells that contain bettles that have not emerged. The work is shown in Fig. 14. The inside of the bean in badly infested specimens is entirely converted into a powdery mass of excreta. Often the beans will contain larvæ in various stages of growth and also beetles. Fig. 15 shows the pupa. Fig. 16 shows the closely related Pea Weevil, enlarged and natural size, which is given for comparison.

FIG. 16. Pea Weevil. a, natural size and enlarged; b, work of the insect.

LIFE HISTORY.

The eggs are laid upon the young bean pods after the flowers have withered, at any point, and sometimes many on a pod. The eggs hatch in a few days and the young larvæ enters the growing bean. It lives upon the substance of the bean making an excavation somewhat larger than itself in which it transforms to the pupa, finally to the beetle state. The beetles may emerge in the fall or at any time during the winter, lay eggs, which hatch and the larvæ enter the same beans or new ones. Successive generations may occur until the food supply is exhausted. Those beetles on the wing during the summer lay their eggs in the pods of the growing crop. The length of time required for the transformations has not been studied but probably is variable with circumstances. We found quite a number of dead beetles within the cells in the beans.

PRECAUTIONS

Experiments have shown that beans infested with *weevils* will not all sprout and that the plants from them are sickly and do not produce a full crop. It is therefore best not to plant them. It is believed upon good authority that beans containing the weevils in the beetle form are probably injurious and unfit food for man or beast.

REMEDIES.

If beans are found to be badly infested so as to be useless for food or seed, they should be *burned at once* so as to prevent the escape of the beetles.

Beans should be kept in a tight box or bag and any beetles that escape in the bag destroyed.

Throw the infested beans into hot water. (The exact amount of heat that beans will stand and germinate is not known but experiments would determine.) We feel sure the germ will stand more heat than the weevils.

Prof. Weed killed pea weevils by exposing the peas to a temperature of 145° F. for an hour. Bean weevils probably could be destroyed in the same way.

Probably the best way is to put the beans into a tight box and fill it with the vapor of *Bisulphide* of *Carbon* and leave it for two or three days. Bisulphide of Carbon is *very inflamable* and no light should be brought near it.

Experiments show that infested beans lack in vitality and when good seed can be had it is best to procure it and not run the risk of perpetuating the pest and growing a crop of weakened plants.

The Pear-Blight Beetle, or Shot-Borer.

Xyleborus pyri, Peck=X. dispar, Fbr.

Order Coleoptera : Family Scolytidæ.

Last summer we received some small apple tree limbs from Professor Munson for examination. They were handed to him by Mr. J. N. Allen, North Sedgwick, Me. We obtained the same insect from Dr. Twitchell about the same time from the vicinity of Augusta. These limbs were literally honey-combed with small channels that extended through the liburnum and heart wood to the centre. The exit holes through the bark were .06 to .08 of an inch in diameter and nearly circular, looking like small shot holes. The wood was green showing that the insect attacks the growing tree. Living wood does not appear to be essential to the life and comfort of this species, for after a period of several weeks we found in a limb that had been in a dry place in a box, young larvæ, full grown larvæ, pupæ and perfect beetles. We put a portion of a small limb (2 inches by 3 inches) in a box and allowed the pupæ to transform and in the fall we found fifty beetles had emerged.

We wrote a short account of this insect at the time for the *Maine Farmer* and called it *Xyleborus pyri*, Peck, the Pear-blight Beetle. To be absolutely certain we sent some specimens to Mr. A. H. Hopkins, Morgantown, West Virginia, who has given special attention to the *Scolytids* and he sent the following reply :

"The beetle you sent is *Xyleborus pyri*, Peck=*X. dispar*, Fbr. This species is quite common in West Virginia, but strange to say, I have never met with it in apple or pear trees. I find it in hemlock, beech, birch and oak. I have specimens of X. dispar from

Germany and though I can detect a slight difference between the females of the European and American form yet there is not difference enough to separate them as distinct species." We have seen this beetle in abundance in juniper about Orono and we have no doubt that it has transferred its depredations from adjacent forest to the orchards. Professor Fletcher reports its increase in Nova Scotia.

Below we give a description, the life history and suggestions for the treatment of this beetle.

DESCRIPTION.

So far as we know the eggs have not been described. They must be very small and are said to be laid at the base of the buds. We have never seen them. The young larvæ bore into the wood making deep channels which in small twigs interfere with the circulation of the sap, and the twigs wither giving the appearance of blight, hence the name PEAR-BLIGHT BEETLE. The work of this beetle should not be confounded with the Pear-blight proper which is caused by a species of bactaria. When the larvæ are full grown they transform to pupæ in the burrows and finally emerge as small beetles about one-tenth of an inch long and of a dark brown or nearly black color, with the antennæ and legs of a rusty red. The thorax is short, very convex, rounded and roughened. The wing covers are marked by longitudinal rows of punctures. The hind part of the body slopes abruptly. The beetle natural size and enlarged are shown in Fig. 17. The beetles leave their burrows in July and deposit eggs before August.

FIG. 17. Pear-blight beetle. Natural size and enlarged.

REMEDIES.

As these beetles work wholly under the bark they cannot be reached by insecticides. The only way is to watch the trees during the latter part of June and July and if blighted twigs or diseased limbs are noticed examine the branches for small pin holes and if found the presence of this or some related species may be suspected. The diseased limb should be cut *at once* below the injury far enough to include all the burrows, and *burned*, for the beetles will transform, emerge and attack new trees. As these beetles live in forest trees orchards near timber would be more likely to become infested.

CARROT FLY—CARROT RUST FLY.

Psila rosæ, Fab.

Order Diptera:

We received the following letter from Mr. Morrell which was accompanied by the *larvæ* and pupæ of a species of fly, also pieces of carrot in which the maggots had been working.

"PITTSFIELD, MAINE, April 6, 1893.

Professor F. L. Harvey:

DEAR SIR—I send little worms which I would like to have you identify. The worms are in our carrots and have made holes all through them, after the manner of those in the piece I send. The carrots were placed in a barrel and the barrel filled up with fine dry sand like that I send. On sifting the sand I find it full of worms. Beets grown side by side with the carrots, and packed in the same kind of sand have no worms. Very truly,

C. H. MORRELL"

Not recognizing the species we wrote Mr. Morrell that the specimens were the larval and pupal stages of a fly that we would have to transform and obtain the flies before identifying it. The infested material being only a barrel of sand and this very fine we suggested sifting it to remove the pupæ and larvæ that had left the carrots to transform and burning the siftings; or heat the whole material with hot water. We received the following reply accompanied with fully *two hundred* pupæ and larvæ.

"PITTSFIELD, MAINE, April 11, 1893.

DEAR SIR—Your card received. For the information, thanks. I have sifted part of the sand and burnt the siftings, and put the rest in boiling water. I don't believe those insects will do any more harm. I send another box of them as you requested.

Very truly,

C. H. MORRELL."

After having reared the flies we wrote Mr. Morrell as follows:

"ORONO, MAINE, May 26, 1893.

Mr. C. H. Morrell:

DEAR SIR—I have reared the flies from the pupæ and larvæ, which were affecting your carrots, and am now able to state that it is the "Rust Fly" or "Carrot Fly" an *imported* species from *England*, which has been giving some trouble since 1886 in Canada but

so far as I know has *never* before been reported from the United States. It is regarded as a very troublesome insect abroad and its introduction here is certainly unfortunate. I am at a loss to suggest how it reached your locality, and will be pleased if you can give me any help in the matter. Have you noticed it before in your place? Please ascertain whether your neighbors have noticed it. Have carrots been imported to your locality, if so, from where? You better watch your carrot bed this season and if the leaves of the young plants turn brown, examine the young roots for the brown rust spots on the surface and the interior for the maggots. If you find them, then after thinning, sift sand saturated with kerosene between the rows, and water heavily to pack the dirt close to the roots so the flies cannot crawl down to lay their eggs.

Respectfully, F. L. HARVEY."

We put the larvæ and pupæ sent by Mr. Morrell into sand in a breeding cage and in about two weeks the flies began to emerge in abundance and continued to come out for two weeks. We transferred some males and females to a jar containing parsnips, as we were not able to get carrots. In a day or two we noticed the females crawling between the leaves and going down to the base of them and though we had not observed them mating presumed they were ovipositing. The next day we broke off a leaf and found the eggs near the base laid on the surface in small clusters and loosely attached to the surface of the leaf. Having now eggs, larvæ, pupæ and flies we made out the following description:

Eggs—.6 mm. long (.024 in.) by .115 mm. broad (.0046 in.) white, oblong, about five times as long as broad, longitudinally marked from end to end by about 10 ridges and furrows which are from centre to centre .022 mm. The furrows between the ridges are marked by about thirty circular pits. The sculpture resembles the surface of a peanut. At one end the egg abruptly narrows and bears an oblong pedicil, twice as broad as long, and one-third the width of the egg at the widest part, (.022 mm. x .044 mm.) The pedicilate end of the egg reminds one of a tied grain sack. See Fig. 18.

FIG. 18. Egg of Psila rosæ × 50 times. (Original.)

Larvæ—6 mm. long, (.25 in.) breadth 1 mm., (.04 in.) legless, white or pale yellow, semi-transparent, head end quite pointed and armed with a pair of black hooks for gnawing. Aboral end

blunt, obliquely docked and bearing on the face of the oblique portion the dark colored caudal spiracles. Third segment from the last longest and somewhat longer than the last two. The sutures between the segment deep. The segments somewhat transversely wrinkled. See Fig. 19.

Fig. 19. Psila rosæ. Larva × 8 times (original.)

Pupæ—5 mm. (.20 in.) long, 1.25 mm. (.05 in.) wide, coarctate, brown, obliquely docked behind. The docked portion bordered by a rim and bearing two black tubercles. Fig. 20 shows dorsal and side views. The form of the pupæ is quite variable. Some have two tubercles at the head end and the black candol spiracles show on the oblique end. Some have the sides parallel while others are quite fusiform. The surface is quite wrinkled. Some are fully a fifth longer than others.

Fig. 20. Psila rosæ. Pupæ × 8 times (original.)

Flies—Length 6 mm. (.25 in.) Wings 3.5 mm. long (14 in.) and extending nearly half their length beyond the abdomen, thin and iridescent. Abdomen and thorax shining pitch black clothed with short grayish pubescence. Head pale orange or yellowish; eyes dark brown; Antennæ basal joint general color of head, terminal joint nearly black, bristles light. A spot above the mouth black, palpi black, proboscis very prominent, oblong and armed with many short hairs. Legs pale yellowish brown. Abdomen ovate. Scutellum raised and bearing two bristles. Arista armed with short hairs. About eight bristles on the mesothorax. The flies have the habit of opening and closing the wings, which are quite iridescent in the sunlight. The males are smaller than the females. Fig. 21 shows the form and veining of the wing. If the veining of the wing s o *Psila rosœ* are correctly shown in the small cut in United States Agricultural Report, 1893, p. 133 then serious doubt arises regarding the determination for the veining of the wings of our specimens are quite different. Probably in so small a cut accuracy was not considered essential.

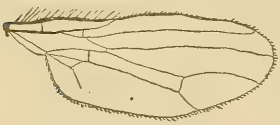


Fig. 21. Psila rosæ, wing × 10 (original.)

INDEX